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No. 78

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UDC 531.3+629.439+62-52

BANKING ON CURVED SECTIONS OF TRACK FOR HIGH-SPEED SURFACE TRANSPORTATION

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: MASHINOSTROYENIYE in Russian No 1, Jan 81 pp 100-104 manuscript received 7 Feb 79

OSINOVSKIY, L. L., candidate of technical sciences, docent

[Abstract] The enormous interest throughout the world in high-speed surface transportation has led to intense research both on fundamentally new problems inherent only in such transportation, and on some conventional problems of transport in general, such as banking on curved sections of track. In this paper a method is proposed for calculating the necessary banking of a vehicle either by inclination of the track structure or by tilting the car with a system for automatic banking control. It is shown that in either event the calculation can be based on the same initial formulas, which may be simplified depending on the method of banking. Recommendations are made on laying curved track. Figures 2.
[125-6610]

UDC 621.33.001.18

PROBLEMS AND PROSPECTS IN THE DEVELOPMENT OF ELECTRIC LOCOMOTIVE CONSTRUCTION

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 4, Apr 81 pp 349-354

KUROCHKA, Aleksandr Leont'yevich, doctor of technical sciences, science project director, Rostov Institute of Railroad Transportation Engineers,
YANOV, Viktor Petrovich, candidate of technical sciences, director of the All-Union Scientific Research Institute for Design and Planning in Electric Locomotive Construction, and SKOGOREV, Ivan Vasil'yevich, candidate of technical sciences, deputy director of science projects, All-Union Scientific Research Institute for Design and Planning in Electric Locomotive Construction

[Abstract] The article reviews the current state of freight haulage on electrified railroads of the USSR, and examines some of the problems that must be solved to

improve this sector of the national economy during the 11th Five-Year Plan. Among these problems are improving the specific traction and power of electric locomotives, developing optimum arrangements of powerplant and auxiliary systems, reducing labor inputs in manufacturing, servicing and repair, improving energy indices and reducing material inputs in optimization of reliability and efficiency of electric locomotive operation. To meet these problems, several projects are now under development at the All-Union Scientific Research Institute for Design and Planning in Electric Locomotive Construction and the Novocherkassk Electric Locomotive Plant. One advance has been development of the VL80S locomotive based on series-produced eight-axle electric locomotives for alternating current. These engines are equipped for tandem operation from a a single cab manned by one locomotive crew. A two-engine tandem rig has a traction force of 90 metric tons. The Tbilisi Electric Locomotive Plant has developed the VL11 locomotive for operation on D-C roads. A new engine soon to be released by the Novocherkassk Plant is the VL80R with recuperative braking. These units are expected to reduce energy consumption in train work by 18-20%. A new group of eight-axle and twelve-axle locomotives will be developed and produced in the 11th Five-Year Plan with increased power per axle and greater traction than existing engines. Programs for railroad improvement also include improvement of automation and development of new construction and insulating materials. References: 4 Russian.
[124-6610]

MARINE AND SHIPBUILDING

UDC 829.12.037-192

IMPROVING THE RELIABILITY OF ASSEMBLED PROPELLER SCREWS

Leningrad SUDOSTROYENIYE in Russian No 4, Apr 81 pp 41-42

VYSOKORODOV, N. S., TIMONIN, V. M., YAROSHENKO, M. V. and SAKHELASHVILI, V. N.

[Abstract] Assembled propeller screws with individual blades pressed onto the hub are found in wider use now because of their advantages over integrally cast ones, namely much easier repair and replacement. Experience has revealed, however, that these propeller screws are not as reliable in service. It is thus necessary to improve the design. Accordingly, the maximum bending moments and the residual shaft rotation angle have been both calculated and measured for hubs before and after case hardening on shafts made of carbon steel (grade St 5) or of 12Kh18N10T (chrome nickel) steel, with the press fit varying from 0.06 to 0.11 mm clearance. An analysis of the results based on structural mechanics indicates that only within a certain range of clearances can the press fit be tightened to avoid loosening under a cyclic load on the one hand and not to exceed allowable stresses on the other, these two limits of this range depending on the relevant dimensions, the drag torque and the modulus of elasticity. Figures 1; tables 1; references: 5 Russian. [141-2415]

UDC 629.12.037.4-578

EXPERIENCE WITH THE USE OF HIGHLY ELASTIC SLEEVE COUPLINGS IN MARINE POWERPLANTS

Leningrad SUDOSTROYENIYE in Russian No 4, Apr 81 pp 23-26

CHERNOV, S. Ye.

[Abstract] The performance of highly elastic rubber sleeve couplings "Vukan ESZ" (made in Germany) in multishaft ship propulsion systems is analyzed, particularly with regard to torques and stresses, vibration and resonance characteristics, and heating. The data taken on three passenger steamships ("Maksim Gor'kiy", "Kliment Voroshilov", "Anton Chekhov") indicate that shaft rotation in the turbine mode

imposes the heaviest duty on such a coupling and is the main source of overloads. Inspection after 8-10,000 h of operation revealed appreciable cracking. The surface temperature did not exceed 50°C, 7-28°C above the ambient air temperature, thus remaining well below the recommended 60°C limit. The maximum permissible torques during continuous duty and during quick passage through resonance are determined from engineering design formulas and data in the manufacturer's catalog for each specific case. Calculations are checked against torsiograms, which read somewhat higher operating torques. An inspection and replacement schedule has been set up, some critical items on the outside surface needing to be checked as often as every 300-350 h and some items on the inside surface needing to be checked only every 8-10,000 h. Figure 1; tables 4, references 5: 4 Russian, 1 Western.
[141-2415]

UDC 629.12.053.1/.2"313"

OUTLOOK FOR IMPROVEMENT OF LOG RECORDERS AND MAGNETIC COMPASSES

Leningrad SUDOSTROYENIYE in Russian No 2, Feb 81 pp 34-35

IVANCHENKOV, V. P.

[Abstract] An important trend is standardization of equipment whereby obsolescent equipment can be replaced with new, standardized models. The electronic induction log IEL-2M was used to replace obsolete models removed by attrition from 1955-1970: the IEL-2M received the silver medal at the VDNKh in 1979. Small displays were developed to display information about ship's speed, gyroscopic compasses and navigational radar. Further improvements envisioned for ship's logs and magnetic compasses include the following: microprocessor control, improved data accuracy, multi-input processing, reduction of electrical interconnections, weight and size. The leading trend will be the use of microelectronic devices, use of advanced methods of shaping, reduction of metal content of designs, increased corrosion resistance of on-board sensors. Improvement of magnetic compasses will be based on the use of nonmetallic materials for support structures and new magnetic materials and fluids for sensing elements. Figure 1; references: 2 Russian.
[87-8617]

UDC 629.12.013/.015"313"

BASIC TRENDS IN THE DEVELOPMENT OF MARINE DEVICES

Leningrad SUDOSTROYENIYE in Russian No 2, Feb 81 pp 20-22

REZCHIK, Yu. I.

[Abstract] Some of the modern achievements in marine equipment include: KEG63028 cargo crane with electric-hydraulic drive, replacing the KEG12018; devices for athwartship transfer of dry and liquid cargoes at sea; design of several hoisting devices for operation with underwater equipment such as the "TINRO-2" and "Paysis"; mass production of KGGPM-1348 industrial loading devices including eight mechanisms powered by a common hydraulic system; production of wharf mechanization and deck transportation; deep anchorage devices for depths up to 500 meters. Among the future problems facing shipbuilders are conquest of the continental shelf, and study and conquest of the world's oceans. Much depends on carrying out research on the high seas. Work to be done in the future will revolve around the development of a program for specialization of enterprises to eliminate duplication of effort, removal from production of obsolete devices, universal reduction in labor intensiveness of manufacturing processes and enhancement of their reliability. The success in solving the problems named above depends on the quality and time frame of diliveries by other sectors cooperating in the construction of marine devices. Figures 2, references: 6 Russian.
[87-8617]

UDC 621.311.22.002.51:621.651.001.4

EVALUATION OF THE PERFORMANCE OF THE OPVZ-185EG MAIN CIRCULATION PUMPS IN AN 800 MW POWER UNIT

Moscow ELEKTRICHESKIYE STANTSII in Russian No 5, May 81 pp 30-34

ROGOVOY, T. N., engineer, and KIKISH, O. V., engineer, Southern Regional Administration of Power System Engineering Management

[Abstract] Cooling water in the 800 MW power units of the Zaporozhskaya and the Uglegorskaya state regional electric power plants is circulated by vertical rotary-vane pumps OPVZ-185EG. Such pumps are also to be installed in the first 440 MW power unit of the Rovenskaya Atomic Electric Power Plant as well as in the first 800 MW power units of the Zuyevskaya and the Permskaya state regional electric power plants and in the first 1000 MW power unit of the Yuzhnaya-Ukrainskaya Atomic Electric Power Plant. These pumps are custom-built for 2-speed operation, 4.83 or 6.08 rps, at which they deliver a pressure head of 157 and 245 kPa respectively and deliver 12 and 15 m^3/s respectively with an efficiency of 85% at both speeds. They have been tested in service, immediately after routine shutdowns, and their actual performance was checked against factory guarantees. When operating beyond manufacturer's specifications, they vibrate excessively with knocking of the runner and with spontaneous tilting of the vanes from their set $0°30^8$ angle position, especially under transient conditions. The electrohydraulic vane steering mechanism requires some improvements which will ensure more reliable operation. An OPVZ-185 EG pump should be started on the low-speed side, with a switchover to the high-speed side within 10-15 s after the drive motor has been connected to the power line. It should then be switched back to low speed, if operation at that speed is required. Figures 5, tables 1.
[151-2415]

UDC (621.311.25:621.039).07

REGULATION OF POWER UNITS WITH WATER-COOLED REACTORS DURING SYSTEM PERTURBATIONS

Moscow ELEKTRICHESKIYE STANTSII in Russian No 5, May 81 pp 6-9

GUREVICH, M. Kh., candidate of technical sciences, GOLOVACH, Ye. A., candidate of technical sciences, and SEN'KIN, V. I., candidate of technical sciences, Scientific-Industrial Association, Central Boiler and Turbine Institute

[Abstract] The transient performance of automatically operating power units with water-cooled water-moderated power reactors VVER-400,1000 as well as of those with a uranium-graphite channel reactor RBMK-1000 during system perturbations of the severest kind such as load jumping due to power shortages depends largely on the ability of the regulation system to maintain the basic process characteristics. A power unit consists essentially of the reactor with shielding, a steam generator, a turbine, a condenser and an ionization chamber. The parameters to be regulated are the thermal power of the reactor, the steam pressure in the header and the power output of the turbine. The steam pressure in the header is uniquely related to the temperature before the turbine entrance and, at the same time, indirectly indicates changes in the water level in the steam generator. Calculations of transients covering a period of 4 min and based on computer simulation of the appropriate nonlinear differential equations (programmed in FORTRAN-4 and ALGOL-1204) reveal that power units with water-cooled reactors feature a high pickup. Replacing uncoupled regulation with semicoupled regulation is found to appreciably decrease the dynamic deviations of steam pressure and reactor power from their steady-state levels. Another way to improve the performance of power units with regulation is to program the latter for a constant mean temperature of the heat carrier in the first loop over a range of power changes down to 70% of nominal. Figures 5, references: 10 Russian.
[151-2415]

UDC (621.311.25:621.039.534):546.3:658.562:654.931.94

REMOTE INSPECTION OF THE METAL IN THE PRIMARY CIRCUITS OF ATOMIC ELECTRIC POWER PLANTS

Moscow ELEKTRICHESKIYE STANTSII in Russian No 3, Mar 81 pp 10-12

GREBENNIK, V. S., candidate of technical sciences, BRODSKIY, B. R., candidate of technical sciences, and ZLEPKO, V. F., candidate of technical sciences, All-Union Institute of Heat Engineering

[Abstract] Remote nondestructive inspection of thermomechanical equipment such as piping is an essential ingredient of successful planning and construction of atomic

electric power plants. It has already been instituted in various such plants, including plants with water-cooled water-moderated power reactors, but there is still a great need for further improvement from both the inspection equipment producer's and user's technoeconomic standpoints. Inspection of metal parts, particularly welds, requires instruments that are sensitive, give stable readings, can be quickly set up and dismantled, feature a high degree of universality, are compact, easily deactivated and easily repairable. The inspection results must be reproducible and their information content reliable, to allow for a rational interpretation of data and documentation of defect characteristics they reveal. Two methods of remote nondestructive inspection appear to be most suitable for this application, emission of elastic stress waves and ultrasonic flaw detection, especially when they are combined to supplement each other. Modern ultrasonic flaw detectors are extremely sensitive on the 2 mm^2 level to cracks with openings as narrow as 10^{-6} mm; emission of elastic stress waves is an excellent monitor of fracture kinetics through the stages of plastic deformation and crack development. References: 9 Russian.
[150-2415]

UDC 621.165.62-5

BASIC PRINCIPLES OF DESIGNING OPTIMUM ELECTROFLUIDIC CONTROL SYSTEMS FOR STEAM TURBINES IN ATOMIC ELECTRIC POWER PLANTS

Moscow TEPLOENERGETIKA in Russian No 6, Jun 81 pp 37-40

BAL'ZAMOV, B. N., candidate of technical sciences, GAPUNIN, A. Ya., candidate of technical sciences, NIKITIN, Yu. V., candidate of technical sciences, KLOCHKO, V. A., engineer, and MIRNYY, V. A., engineer

[Abstract] Electrofluidic control systems are used for steam turbines in atomic electric power plants and, as larger power units are being installed, the performance of these systems must meet more severe requirements. Since no proven method of their design and synthesis is available, there is a need for scientifically based development and implementation of control principles and equipment. The main objectives should be an algorithmically complete theory of optimum control, in deterministic and stochastic versions, and utilization of highly efficient computer facilities capable of handling transient processes. Here these objectives are discussed as they apply, specifically, to 200-1000 MW steam turbines and their dynamic characteristics and to electrofluidic control systems for multimode operation. The first step of synthesis should be formulation of linearized equations of state control, this step followed by reduction of the dimensionality of the state space and definition of quality criteria. The final step should be simulation, where these models are needed: a model of random intrasystem perturbations, a model of

measurement noises, and a model of the electronic part of an electrofluidic control system with the instability of analog devices taken into account. Slow transients of random variations are best described by Brownian movement and the integral of white noise. Description of very slow transients requires determination of not only intensities but also correlation times. All these concepts have been applied to a control system for a K-1000-60/1500 turbine and tested in the frequency-holding mode. The maximum errors of frequency regulation did not exceed 0.1% of the nominal level. References: 3 Russian.
[132-2415]

UDC 621.039.526

DEVELOPMENT OF SCIENTIFIC AND TECHNICAL FOUNDATIONS OF BREEDER REACTORS

Moscow ATOMNAYA ENERGIYA in Russian Vol 50, No 2, Feb 81 pp 102-110

TROYANOV, M. F.

[Abstract] The state of the art in breeder reactors involves the intensive accumulation of operating experience. BN-350 and BN-600 are operating in the USSR; the Phénix in France, the PFR in the United Kingdom. Started up in April 1980, the BN-600 reached nominal capacity in September 1980. The BR-10 and BOR-60 in the USSR, the Rapsodie in France, the EBR II in the United States, the KNK II in West Germany and the Dzeyo in Japan have been employed to carry out an extensive program of research on all aspects of breeder technology and sodium cooling. The United States FFTF reached criticality in 1980, opening up a wealth of research opportunities. All breeder reactors in service operate with sodium cooling. Sodium-cooled breeders are the concept of the future, too: the BN-1600 and BN-800 in the Soviet Union, the Superphénix with its 1200 MW capacity in France, and the CDFR in the United Kingdom, are to be sodium-cooled breeders. Thermal exchange, various construction materials, fuel elements and cassettes are considered. Tables 2, references 37: 32 Russian, 5 Western.
[83-8617]

UDC 621.039.584

RADIATION SAFETY OF SERIALLY MANUFACTURED AES WITH THE VVER-440 WATER-COOLED WATER-MODERATED REACTOR

Moscow ATOMNAYA ENERGIYA in Russian Vol 50, No 2, Feb 81 pp 99-102
manuscript received 20 May 80

DICHEV, G., KHITOV, G. (Bulgaria); SCHREITER, W., BABENZINE, H. (East Germany);
VORONIN, L. M., VOLKOV, A. P., KOZLOV, V. F. and SEDOV, V. K. (USSR)

[Abstract] By 1979, the "Kozloduy" AES had been in service over four years; the first and second plants of the "Bruno Leuchner" AES in Greifswald--over 4 years; the third plant almost two years; the third and fourth plants of the Novovoronezhskaya AES about 6-7 years; the first plant of the Kol'skaya AES about six years, the second plant more than four years. The published data bear witness to the reliable radiation safety protection afford personnel and adjacent populations. When the reactor is operating at rated output, the level of penetrating emission generally does not exceed 2.8 and 1.4 millirems (1 rem = 0.01 J/kg) established by health regulations for planning AES with respect to occasionally serviced and continuously manned areas respectively. Increased radiactive contamination of soil, plants and cereals could not be found after operation of any of the plants. Radioactive iodine content in cow's milk did not exceed $(1.0\text{-}1.3)\times10^{-12}$ Ci/liter during the pasturing and grazing period. Thus the theoretical and actual doses of exterior and interior radiation in the region of AES with VVER-440 is two to three orders below the lowest permissible values. Tables 4, references 7: 6 Russian, 1 Western.
[83-8617]

UDC 621.311.2:621.039

VVER-1000 WATER-COOLED WATER-MODERATED REACTOR: ASPECTS OF THE PROJECT, RESULTS OF START-UP OF THE FIFTH PLANT OF THE NOVOVORONEZHSKAYA AES AND MEANS OF FURTHER IMPROVEMENT OF THE INSTALLATION

Moscow ATOMNAYA ENERGIYA in Russian Vol 50, No 2, Feb 81 pp 87-93

VIKHOREV, Yu. V., VOZNESENSKIY, V. A., DENISOV, V. P., DUKHOVENSKIY, A. S., ISAKOV, N. A., KAMYSHAN, A. N., SEDOV, V. K., SIDORENKO, V. A. and STEKOL'NIKOV, V.V.

[Abstract] The fifth plant of the Novovoronezhskaya AES (NVAES), whose construction was begun in 1972, has been put into operation, the leading one among a large number of AES with vessel power reactors of the VVER-1000 type. The project was implemented by the Institute of Teploelektroproyekt, the head designer of the

nuclear steam generation plant was the special design office of Gidropres; scientific supervision of developments was provided by the Institute of Atomic Energy imeni I. V. Kurchatov, The aim of the plant was to develop a capacity of 1,000 MW using equipment which could be carried by rail and, by greatly increasing its unit capacity, to improve specific technical and economic indicators. Transportation constraints limit the vessel diameter to 450-460 centimeters. Fuel elements 9.1 mm in diameter were selected; the water/uranium surface ratio was 1.85. The core holds 151 fuel cassettes. Control systems include boron and mechanical. Control elements are divided into 14 symmetrical groups, two of which contain a half-length absorber to equalize axial power distribution. A table compares the characteristics of VVER-1000 variants: the fifth plant of NVAES, first updating stage, and the second updating stage. Table 1, references: 2 Russian.
[83-8617]

UDC 621.039.572

FEASIBILITY OF INCREASING THE POWER OF IRT REACTORS

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 101, No 3, Mar 81 pp 657-660 manuscript received 31 July 80

ABRAMIDZE, Sh. P., GARSEVANISHVILI, G. N., INASHVILI, A. V. and KIKNADZE, G. G., Institute of Physics, GSSR Academy of Sciences

[Abstract] A method is considered for increasing the power of IRT reactors based on intensifying heat exchange in the core by two-dimensional artificial roughness and introducing an additional loop for cooling the water in the reactor pool. The calculations were based on the equations of heat balance and heat transfer, and also Newton-Riechmann equations. An analysis was made of the process of bringing the reactor up to steady-state operation at a predetermined power level. The computer program is based on breaking down the continuous process of transient startup into a number of sequential cycles in which the temperature of the water entering the core is taken as constant. The water temperature on each succeeding cycle was taken as the temperature of mixing of the water in the pool and the water entering the pool in the cycle after being cooled in the heat exchangers. The calculations enabled determination of the coolant temperature at different points of the cooling system and the wall temperature of the fuel assembly both during the transient process and after establishment of the steady state. Consideration was taken of nonuniformity of heat release in the core both radially and heightwise. Various configurations of smooth and "rough" fuel assemblies and arrangements of the additional heat exchanger were examined. It was found that the addition of a cooling loop has the most favorable effect. A reactor power of 17 MW is attained at an inlet water temperature of 25°C in the secondary circuit, pool temperature of

54°C and maximum wall temperature in the fuel assembly of 105°C. It is concluded that the power of the IRT reactor could be raised to 20 MW by increasing the flowrate of the coolant in the core if the coefficient of heat transfer is slightly higher than assumed in the calculations. Figures 3, references 7: 6 Russian, 1 Western.
[139-6610]

UDC 621.039.55

EXPERIMENTAL FACILITY AND SOME RESULTS OF INVESTIGATION OF THE WORKING CAPACITY OF FLAWED FUEL ELEMENT MODELS IN THE BRIG-300 REACTOR

Minsk IZVESTIYA AKADEMII NAUK BSSR: SERIYA FIZIKO-ENERGETICHESKIKH NAUK in Russian No 2, Apr-Jun 81 pp 34-36 manuscript received 22 Sep 80

GOL'TSEV, V. P., DEVOYNO, A. N., KARPENKO, G. D., GOLOVNYA, V. N., BURNOS, V. V. and LAVRUK, A. G., Institute of Nuclear Power Engineering, BSSR Academy of Sciences

[Abstract] The article describes a high-pressure facility on dissociating nitrogen tetroxide for testing the working capacity of defective fuel elements. A diagram of the facility is shown in Fig. 1. Two ND-100/250 pumps (1 in the diagram) circulate the nitrogen tetroxide. The coolant in liquid phase from working tank 8 is circulated by pump system 1 through filters 10 to damper tank 2, where a gas cushion smooths out pulsations of pressure. From tank 2 the nitrogen tetroxide goes to controlled tubular electric heater 3 where N_2O_4 is converted from the liquid to the gaseous phase. The dissociating gas system goes to experimental working section 4 and then to air cooler 5, where partial recombination takes place, after which the gas is condensed upon passage through water cooler 6 with formation of the liquid phase and the required degree of supercooling. The supercooled N_2O_4 is then returned to tank 8. A valve system enables measurements of the flowrate of coolant in measurement vessel 7. Fig. 2 shows a diagram of the experimental working section (4 in Fig. 1). Housing 1 is a stainless steel tube that holds fuel element model 2 with artificially produced point defects on the cladding. The defective element is held by sleeves 3, 4 and screw 5, which are connected in turn to tubes 6 for inlet and outlet of the coolant. Filters 7 at each end of the fuel element prevent products of nuclear fuel corrosion from being circulated through the facility with the coolant. Tests at 723 K and 77-80 kgf/cm^2 for 300 hours showed that defective fuel elements remain operable, and that the nuclear fuel does not react with the cladding.

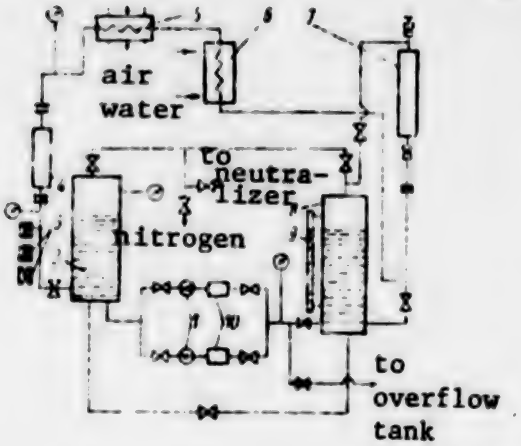


Fig. 1

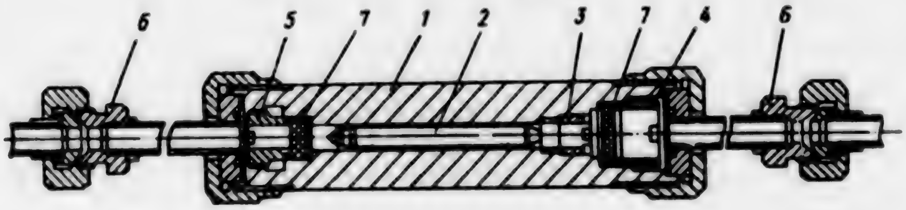


Fig. 2

Figures 2, references: 2 Russian.
[138-6610]

UDC 621.039.54

PROBLEM OF WORKING CAPACITY OF FUEL ELEMENTS IN A GAS-COOLED FAST REACTOR WHEN THERE IS A GAS GAP BETWEEN THE FUEL AND CLADDING

Minsk IZVESTIYA AKADEMII NAUK BSSR: SERIYA FIZIKO-ENERGETICHESKIKH NAUK in Russian No 2, Apr-Jun 81 pp 55-59 manuscript received 22 Sep 80

KULIKOV, I. S., NESTERENKO, V. B. and TVERKOVKIN, B. Ye., Institute of Nuclear Power Engineering, BSSR Academy of Sciences

[Abstract] The main problem of operability of a fuel element with gas gap is stability of the cladding. Previous research has shown that the cladding of a rod fuel element loaded by coolant pressure of 160 kgf/cm^2 can be kept operable throughout the reactor run if an initial pressure is set up in the gap under normal conditions of 30-40 kgf/cm^2. In this paper the authors calculate the conditions of combined operation of fuel element and cladding over a prolonged period in a fast reactor cooled by dissociating N_2O_4. The condition of the fuel element is broken down into short time intervals, and the principal mechanical and thermophysical characteristics are determined in each interval. The results show that with respect to such important parameters as thermal stability of the fuel core and

strength of cladding, the element retains working capacity for prolonged periods. At the same time, it is pointed out that the results are valid only for our current level of knowledge on the properties of structural and fuel materials. Figures 2, references 10: 6 Russian, 4 Western.
[138-6610]

UDC 519.95

VECTOR OPTIMIZATION AS A BASIS FOR SELECTING THE PARAMETERS OF STEAM GENERATORS IN A NUCLEAR ELECTRIC PLANT

Minsk IZVESTIYA AKADEMII NAUK BSSR: SERIYA FIZIKO-ENERGETICHESKIKH NAUK in Russian No 2, Apr-Jun 81 pp 60-65 manuscript received 13 Aug 80

LEMESHEV, V. U. and METREVELI, D. G., Institute of Nuclear Power Engineering, BSSR Academy of Sciences, Computing Center, GSSR Academy of Sciences

[Abstract] An examination is made of a multicriterial problem of designing a system given on a set of variable parameters such that each subset corresponds to a single definite system, the quality of this system being evaluated by a given vector function. The optimum solutions are undominated, and specifically Pareto-optimum. Necessary and sufficient conditions of nondominance are derived, and used as a basis for selecting Pareto-optimum parameters of a shell-and-tube counterflow steam-raising unit for a nuclear power facility of the BRGD type. The problem is solved on a YeS-1040 computer, using a program written in FORTRAN. References 10: 9 Russian, 1 Western.
[138-6610]

UDC [621.311.25:621.039]:621.181.6

USING VERTICAL STEAM-RAISING UNITS TO FURTHER IMPROVE GENERATING FACILITIES WITH VVER REACTORS

Moscow ENERGOMASHINOSTROYENIYE in Russian No 3, Mar 81 pp 2-4

KOTOV, Yu. V. candidate of technical sciences, MARKOV, N. M., doctor of technical sciences, TERENT'YEV, I. K., candidate of technical sciences, BACHILO, L. L., KELIN, G. Ye., engineers, PISKAREV, A. A., GRINMAN, M. I., candidates of technical sciences, and KRUGLIKOV, P. A., engineer

[Abstract] It is shown that when horizontal steam-raising units are used in the VVER-1000 generating units of nuclear electric plants there is no opportunity for

further improvement of the parameters of the secondary loop without changing the parameters of the primary loop. The situation changes when a vertical steam-raising unit is used since an economizer section can be created by using part of the heating surface of the unit to warm the feed water from the temperature at the outlet of the turbine regeneration system to the saturation point corresponding to the steam pressure. Calculations show that with this thermal arrangement a higher steam pressure can be attained in the secondary loop without changing the parameters of the primary loop with minimum temperature head at the beginning of the evaporative section. A cost analysis shows that introduction of the proposed arrangement could save more than a million rubles in capital investments and about 700,000 rubles in normalized expenditures each year, which is equivalent to a reduction in specific capital investments of 4 rubles/kW. Figures 2.
[120-6610]

UDC 621.039.53

EXPERIENCE IN USING CARBON STEEL UNDER UNCORRECTED WATER-CHEMISTRY CONDITIONS AT THE VK-50 NUCLEAR ELECTRIC FACILITY

Moscow ATOMNAYA ENERGIYA in Russian Vol 49, No 4, Oct 80 pp 229-232
manuscript received 7 Jan 80

ZABELIN, A. I., ANDREYEVA, A. B., YESHCHERKIN, V. M., STUPINA, L. N., KORNILOV, A. S., SHMELEV, V. Ye. and CHECHETKIN, Yu. V.

[Abstract] The paper gives the results of a study of the water chemistry conditions, the corrosion state of carbon steel and the stability of protective films on the surface of tubing in the primary circulation loop of the VK-50 nuclear electric plant. Circulation of the coolant in this facility is as follows. Saturated steam generated in the reactor is fed through high-pressure and low-pressure separators directly to an AK-70-13 turbine. The spent steam condensate is sent by condensate pumps through two low-pressure heater stages to a deaerator of atmospheric type. The deaerated condensate is fed by high-pressure feed pumps to the reactor and to the cooling mechanisms of the reactor control system. Inspection showed a satisfactory corrosion state of the carbon steel surfaces in the primary loop after 100,000 hours of operation. Oxide films formed during operation afford constant protection of the metal from corrosion during use, and for 2400-4000 hours during shutdown. Preliminary results of corrosion studies in the case of oxidative water chemistry after about 8000 hours of operation show a reduction in the corrosion of carbon steel in the condensate-feed channel as evidenced by a reduction in the content of products of corrosion in the coolant and the presence of maghemite in the oxide films, which enhances protection. It is concluded that carbon steel can be used as a basic structural material in nuclear facilities. Figure 1, references 6: 2 Russian, 4 Western.
[129-6610]

UDC 621.039.566:621.039.517

OPTIMIZATION OF VVER-440 REACTOR ENERGY DISTRIBUTION

Moscow ATOMNAYA ENERGIYA in Russian Vol 49, No 4, Oct 80 pp 254-255
manuscript received 14 Jan 80

POBEDIN, V. V. and SIMONOV, V. D.

[Abstract] The article gives the results of using a method proposed by the authors for minimizing the nonuniformity of energy distribution of a reactor to optimize seven consecutive charges of the VVER-440 reactor. The composition of the initial charge and the configuration of the control rods were taken from data in the literature. Upon completion of a routine run, the cassettes with the greatest burnup were removed, and the depletion was made up with fresh fuel with 2.4 and 3.6% enrichment. The optimum configuration of the fuel corresponding to the minimum coefficient of nonuniformity of radial energy distribution was determined at the start of each run with retention of 30° symmetry of the core. Tables are given summarizing data on the depth of burnup of the fuel and the duration of the consecutive runs with minimized nonuniformity of energy distribution, and also on the radial and volumetric coefficients of nonuniformity for the seven runs. The results show improvement in uniformity of energy distribution, increased depth of burnup of fuel with 3.6% enrichment, and an increase in the total energy production of the reactor over the seven runs. References: 5 Russian.
[129-6610]

UDC 621.314:621.317.784

DEVICE FOR POWER MEASUREMENT AND PROTECTION OF A TURBOGENERATOR AGAINST MOTORING

Moscow ELEKTRICHESKIYE STANTSII in Russian No 5, May 81 pp 38-40

KIZILOV, V. U., candidate of technical sciences, KURBANGALIYEV, U. K., engineer, and MAKSIMOV, V. M., candidate of technical sciences, Central Dispatch Control in the USSR Unified Power System, Khar'kov Polytechnic Institute

[Abstract] An instrument transducer for 3-phase power measurement has been developed which, in addition to carrying a continuous current signal of ±5 mA, has a relay with not only a contactor output independently set for forward and reverse power flow but also an isolated standard contactless output delivering ±10 V or ±5 mA. The input of this relay is connected between two stages of a unifying output amplifier, this amplifier receiving signals from two single-phase power transducers connected according to the 2-wattmeter method. Both transducers have a common power supply and measure the 3-phase line power through current transformers and potential transformers. Each single-phase transducer includes a multiplier consisting of a pulse-width modulator and an amplitude modulator, the former built on a transistor-magnetic multivibrator with negative feedback of the core magnetization reversal speed through an integrated-circuit operational amplifier. Here the performance of this device is analyzed on the basis of circuit relations and multivibrator characteristics during the two portions of a cycle. The performance has been checked experimentally for accuracy and stability. The device has been operating since 1978 in the State Regional Electric Power Plant imeni Klasson of the Moscow Regional Administration of Power System Management, where it protects gas turbines against motoring. Figures 3, references: 5 Russian.
[151-2415]

UDC 621.313.322-82:621.311.21

PERFORMANCE OF HYDROGENERATORS THROUGH A PARTIAL-PHASE AUTOTRANSFORMER BANK IN LARGE UNITS OF HYDROELECTRIC POWER PLANTS

Moscow ELEKTRICHESKIYE STANTSII in Russian No 3, Mar 81 pp 33-37

ANANYANTS, S. S., candidate of technical sciences, GUSHCHIN, Ye. V., engineer, YURASOV, V. T., engineer, SMIRNOV, N. Ye., engineer, and FEODORIDI, P. I., engineer, All-Union Scientific Research Institute of Power Engineering, Kazakh Regional Power Alignment Administration

[Abstract] In large hydroelectric power plants two or three generators are usually connected to one transformer or autotransformer bank. Here the performance of a 13.8 kV Y-connected 88.3 MVA - 75 MW generator with indirect cooling under conditions of phase unbalance or a lost phase in the autotransformer bank is analyzed on the basis of test results, a situation like this being particularly critical when the power plant supplies the peak load. Temperature measurements, especially in the rotor pole structures, indicate safe continuous operation with a 20% phase unbalance where the largest current is not higher than nominal. Momentary asymmetric modes of operation were also found to satisfy the standard limiting criterion $I_2^2t \leq 40$ s with a sufficiently large margin. Vibration measurements indicate that the condition of steel structures deteriorates toward the end of the period between routine shutdowns, even under symmetric conditions of operations, which calls for a rescheduling of routine shutdowns. Under asymmetric conditions, moreover, vibrations exceed levels permissible under symmetric conditions, which calls for some redesign. Asymmetric operation at a 65% load level is tolerable for the length of time required to repair the damaged phase, with stator core maintained at a temperature of 70-80°C so as to reduce the vibrations somewhat. The protective relaying and communication system were found to operate satisfactorily during loss of a phase, no detrimental effect of negative-sequence currents on the telephone channels having been recorded at all. Figures 4, references: 4 Russian.
[150-2415]

UDC 621.184.623-192.001.86

OPERATIONAL RELIABILITY OF INJECTION-TYPE STEAM COOLERS IN THE BOILER OF A 500 MW POWER UNIT

Moscow ELEKTRICHESKIYE STANTSII in Russian No 4, Apr 81 pp 65-66

CHERNYAK, V. N., engineer, SMYSHLYAYEV, A. A. and PETROV, Yu. V., engineer, All Union Institute of Heat Engineering, ZiO [expansion not known]

[Abstract] In modern boilers the temperature of fresh steam is regulated by injection of feed water. One such injector, made of 12Kh1MF steel, operating in

the P-57-1 boiler of the Troitskaya State Regional Electric Power Plant is mounted before the exit stage of convective high-pressure superheater. It was inspected after approximately 18,000 hours of boiler operation and found to have become defective. This is ascribed to three causes. A convective high-pressure superheater has usually a lower heat intake than according to design calculations and therefore, the actual temperature behind the baffle superheater is almost 15° C higher than predicted. Furthermore, improper assembly results in additional mechanical stresses. Finally, incidental operation of these steam coolers induces in their structural components, especially in the spray nozzles, severe thermal stresses. Further studies are under way to improve the construction of a steam cooler and thus its reliability. Figures 2, references: 2 Russian.
[152-2415]

UDC 621.313.322-81:621.313.126.001.45

TEST RESULTS PERTAINING TO MORE RELIABLE EXCITATION OF THE AUXILIARY GENERATOR FOR A TVV-800-2UZ TURBOGENERATOR

Moscow ELEKTRICHESKIYE STANTSII in Russian No 4, Apr 81 pp 59-64

NEVMERZHITSKIY, V. I., engineer, Southern Regional Administration of Power System Engineering Management

[Abstract] An auxiliary generator serves as a separate source of excitation for the field winding of a TVV-800-2UZ turbogenerator. An excitation system for this auxiliary generator has been developed and its prototype tested, some drawbacks having been found which need to be eliminated. The auxiliary generator is a 3-phase synchronous generator (940 V - 5700 kVA - 2850 kW - 3000 rpm) with indirect air cooling of both stator and rotor. Its excitation power comes from two parallel thyristor converters and is automatically regulated by an ARV-VG device. The first drawback is that the necessary excitation under no load and under nominal full load is provided only in response to negative control pulses and, consequently, the auxiliary generator does not operate stably without a regulator. This drawback can be eliminated by disconnecting the ARV-VG according to a special procedure. The second drawback is that a change from automatic to manual regulation is effected by means of an automatic regulator with force action, which is not as simple as using an automatic regulator with proportional action. This drawback can be eliminated by changing the ARV-VG setting as a function of electrical quantities in the generator excitation circuit. The third drawback is that forced excitation of the turbogenerator involves redundant action of the ARV-VG in the "decrease" direction while actually the load current of the auxiliary generator (excitation current of the turbogenerator) should be quickly increased. This drawback can be eliminated by regulating the ARV-VG setting as a function of the output signal from the ARV-TG

turbogenerator regulator. On the basis of these recommendations, an excitation system in two variants has been proposed, with the bias signal either independent of or dependent on the generator voltage. Tests in one of the 800 MW power units of the Zaporozhskaya State Regional Electric Power Plant indicate the effectiveness of this scheme. Figures 6, reference: 1 Russian.
[152-2415]

UDC 621.311.22.002.51.62-501.22.001.5

DYNAMIC CHARACTERISTICS OF AN 800 MW POWER UNIT WITH A TMGP-204 BOILER SET

Moscow ELEKTRICHESKIYE STANTSII in Russian No 4, Apr 81 pp 10-15

KOYCHU, M. B., KONDRATENKO, V. G., PERLOVSKIY, P. S. and SIMKIN, B. Ye., engineers, Southern Regional Administration of Power System Engineering Management

[Abstract] The pilot 800 MW power unit in the Zaprozhskaya State Regional Electric Power Plant consists of a uniflow steam boiler TGMP-204, a K-800-240-3 turbine and a TVV-800 generator. The boiler produces supercritical steam (545°C, 26 MPa) at a rate of 2650 metric tons/h under supercharge. High-sulfur petroleum residue is used for fuel, with a low excess air ratio. The set includes also two turbine feed pumps and two air blowers. The dynamic characteristics of this power unit were measured under full load and half load, with perturbations of the feed water rate induced by movement of the turbine regulator valves simultaneous with and proportional to variations of the fuel rate and the air rate. Tests on a special stand with panels were performed under nominal steam pressure and with the high-pressure preheaters in operation. Data on 25 performance parameters were recorded for establishing the degree of stability. From these data, after statistical processing, the authors plotted the complete starting curves (time 20 min) and the amplitude-phase characteristics with respect to power, pressure at the turbine inlet, and temperature rise at the lower radiator section. The results serve as a basis for designing an automatic feed regulator, the temperature behind the ceiling superheater being the most appropriate control parameter for this purpose. Gain and lag increase with decreasing load, pressure deviations in the boiler channel cause appreciable temperature deviations, and the heat retention capacity of the boiler decreases with decreasing load. In addition, the authors also measured the oxygen content in flue gases, in the air perturbation mode and in the fuel perturbation mode. Figures 6, tables 3, references: 4 Russian.
[152-2415]

UDC 629.12.03"313"

PROBLEMS IN THE DEVELOPMENT OF MARINE POWER ENGINEERING

Leningrad SUDOSTROYENIYE in Russian No 2, Feb 81 pp 23-27

SEDAKOV, L. P. and BARAKAN, G. Kh.

[Abstract] The first task of shipbuilding is to increase the rate of ship construction and improve the quality level. The second aspect in the development of the fleet involves the careful management of fuel and other resources. The third problem revolves around environmental protection. These factors have a profound impact on marine engineering and set the standards for the future of the maritime fleet. A disadvantage of earlier steam turbine plants used in ships having over 15-20 MW is their relatively poor fuel economy. Gas turbine power plants have better size and weight indicators, but their installation on world ships is sporadic in nature. The USSR has implenented one gas turbine ship (of the Captain Smirnov type) in recent years: the ship has a dual shaft power plant, with two plants of 18,400 kW each. Recovery of waste heat and other means of utilizing spent energy will be of great benefit in future developments. Work should begin now to plan for the coming decade. References 8: 6 Russian, 2 Western.
[87-8617]

UDC 621.472.001.02

ANALYSIS OF ENERGY, MASS AND DIMENSIONAL CHARACTERISTICS OF TWO-CIRCUIT SOLAR STEAM-TURBINE FACILITIES WITH ORGANIC WORKING FLUIDS

Tashkent GELIOTEKHNIKA in Russian No 1, 1981 pp 5-14 manuscript received 20 Sep 79

GRILIKHES, V. A., GRISHUTIN, M. M. and YEVSEYEV, V. S., Leningrad

[Abstract] The development of solar steam-turbine facilities with organic working fluids is one of the promising fields of solar power. The authors analyze the energy efficiency and the mass and size characteristics of their own solar steam-turbine designs with efficient heat transfer by a diphenyl mixture. It is shown that surface condensers are limited in capabilities for improving efficiency by reducing the lower temperature of the cycle. Besides, at the minimum permissible pressure for surface condensers using diphenyl there are difficulties with cavitation problems in the feed pumps. Jet condensers are suggested as an alternative. Such condensers as an element of the solar steam-turbine facility can circulate the working fluid as well as condensing the steam flow. This improves the efficiency of the facility by eliminating the mechanical pump. Relations are proposed for calculating the overall efficiency and the ratio of area of the radiator to the useful

power generated by the facility. It is shown that these parameters depend appreciably on the flowrate and head characteristics of the jet condenser, and that the energy efficiency and functional reliability of a solar steam-turbine facility can be increased simultaneously without any detrimental effect on the specific area of the radiator by increasing the heat transfer developed on the first nozzle of the jet condenser. A two-circuit facility is proposed in which the jet condenser is the only circulator. Such facilities have improved functional reliability, energy efficiency and mass/size characteristics. Figures 5, references 11: 7 Russian, 4 Western.
[122-6610]

UDC 662.397.004.14

CASCADE PHOTOGENERATORS BASED ON SILICON AND GERMANIUM MATRIX PHOTOVOLTAIC CELLS

Tashkent GELIOTEKHNIKA in Russian No 1, 1981 pp 21-23 manuscript received 27 Dec 79

STREBKOV, D. S., TIKHOMIROVA, V. A. and FEDOSOVA, G. B., All-Union Red Banner
Scientific Research Institute of Current Sources

[Abstract] The conversion efficiency of a photogenerator can be increased by more complete utilization of the radiation spectrum if a cascade design is used in which the radiation that is not utilized in the upper photogenerator made of a material with wider forbidden band then is incident on a lower photogenerator. Calculations have shown that the optimum number of cascades is three. This paper gives the results of practical realization of the idea of cascade photogenerators of matrix type made from germanium and silicon. Cascade connection of matrix type photovoltaic converters enables current matching of the stages of the cascade for series connection and voltage matching for parallel connection by changing the number of sequentially commutated microelements with p-n junctions. The low absorption beyond the chief edge of silicon matrix photogenerators gives the capability of using the region of the spectrum with wavelength of 1.15-1.8 μm that is inactive for silicon. The criterion for stage matching with parallel connection is the condition of equality of the working voltages under the optimum load in each stage, while for series connection the criterion is equality of the working currents. A cascade photovoltaic converter can also be used as a photometer with a wide spectral range of sensitivity. Figures 2, references 4: 2 Russian, 2 Western.
[122-6610]

UDC 662.997:662.93(088.8)

TEST RESULTS OF A SOLAR WATER HEATER WITH THERMAL ACCUMULATOR BASED ON A PHASE TRANSITION

Tashkent GELIOTEKHNIKA in Russian No 1, 1981 pp 40-43 manuscript received 18 Jan 80

TRUSHEVSKIY, S. N., TROKHININ, N. N. and CHISTYAKOV, V. D., All-Union Red Banner Scientific Research Institute of Current Sources

[Abstract] Tests are done on a solar water heater with thermal accumulator based on utilization of the solid-to-liquid phase transition. The heater takes the form of a "hot box" in which heat is conductively transferred to the thermal accumulation material that undergoes a phase transition when the appropriate temperature is reached. The required power of the heater is attained by commutation of the necessary number of basic modules. The design of the basic module is shown in the diagram. Boiler 1 is enclosed in thermal insulation block 3. The boiler is a flat sheet steel vessel measuring 1200x800x35 (42) mm. Inside the boiler is a heat exchanger made of coiled tubing 2. The free space inside the vessel is filled with the thermal accumulation material 5. The heat-receiving surface of the boiler is coated with black enamel. The module is covered by a double thickness of plate glass 4. The thermal accumulation materials were crystal hydrates with melting points of 56.7°C (low-temperature stage) and 73.4°C (high-temperature stage). Calculation shows that a savings of roughly 6 million rubles can be realized by introducing thermal accumulators in the southern territories of the USSR.

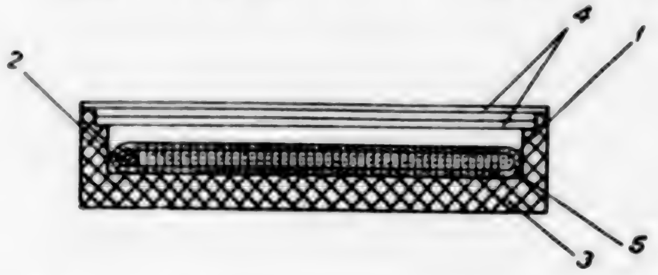


Figure 1, references: 2 Russian.
[122-6610]

UDC 662.997:537.22(088.8)

COMBINED SOLAR ENERGY CONVERTERS WITH SELECTIVE COATINGS

Tashkent GELIOTEKHNIKA in Russian No 1, 1981 pp 54-60 manuscript received 8 Feb 79

KOLTUN, M. M., All-Union Red Banner Scientific Research Institute of Current Sources

[Abstract] The author considers the use of selective optical coatings with special properties to enhance the efficiency of various types of solar energy converters that combine thermal and electric conversion. It is shown that the use of antireflective coatings can be especially effective for increasing the transparency of the upper cells in cascade photogenerators. Multilayer coatings extend the range of solar radiation that is transmitted into the long-wave region. In photothermal converters, the photocells form a collector surface, and are used simultaneously as photogenerators of electric energy, and selective black and white coatings for maximizing the efficiency of converting the energy of solar radiation into both electrical and thermal energy. Such converters should use antireflection-coated silicon photocells without a glass cover. Measurements have shown that a properly designed facility of this kind can convert solar energy to electrical energy with efficiency of 10-12% in combination with thermal energy conversion efficiency of 65-68%. Thermophotoelectric converters that change thermal emission to electric energy and are based on photocells of a comparatively narrow-band semiconductor material are improved by elective coatings that maximize the coincidence of spectral radiation and spectral sensitivity of the cell with simultaneous enhancement of heat exchange between the photovoltaic cell and radiator. The best combination is a radiator of Er_2O_3 and a germanium photocell. References 25: 16 Russian, 9 Western.
[122-6610]

UDC 662.997

CALCULATION AND STUDY OF NATURAL ILLUMINATION OF SOLAR FACILITIES WITH TRANSPARENT FILM COVER

Tashkent GELIOTEKHNIKA in Russian No 1, 1981 pp 73-76 manuscript received 12 Mar 80

BARDIYASHVILI, A. B. and KIM, V. D., Karshi Pedagogical Institute imeni Kh.Alimdzhan

[Abstract] Solar greenhouses with semicylindrical transparent cover of 100 sq. m of useful area and with north-south and east-west orientation were constructed and tested for natural illumination characteristics in 1978-1980 at Karshi State Pedagogical Institute. Systematic actinometric measurements and calculations were made. Simple formulas are given for practical calculations. Figure 1, references: 3 Russian.
[122-6610]

UDC 621.187.16-19

RELIABILITY OF THE HYDRAULIC SCHEME OF SHIELDS OF THE TMP-501 BOILER IN A 500 MW PEAK-LOAD GENERATING FACILITY

Moscow ENERGOMASHINOSTROYENIYE in Russian No 3, Mar 81 pp 22-26

BALDINA, O. M., BELYAKOV, I. I., candidates of technical sciences, and KVETNYY, M.A., engineer

[Abstract] An examination is made of various transient conditions that arise in the shields of the lower radiative section during firing and operation of the peak-load equipment of a TMP-501 boiler unit. A schedule of sliding parameters is proposed to improve operational reliability with maintenance of the nominal pressure up to the built-in slide plate during firing. The boiler should not be fired at a pressure of 7.6 MPa, which corresponds to the minimum load. The transition to low pressure and minimum load after firing should be made following energizing of the high-pressure heaters. To prevent abrupt drops in flowrate in the rear shield of the lower radiative section of the TMP-501 boiler during firing from the cold state, it is recommended that the flowrate of the medium in the boiler be held at 30-40% of the nominal. Figures 5, references: 6 Russian.
[120-6610]

USE OF FACILITIES FOR CLEANING THE OUTER HEATING SURFACES OF BOILERS IN 800 MW GENERATING UNITS

Moscow ENERGETIK in Russian No 4, Apr 81 pp 8-9

YUGAY, Ye. and PAVLYANCHIN, S. G., engineers

[Abstract] The authors discuss the problems encountered in using OPR-5 steam-blast cleaners for slag removal in boilers at the Slavyansk State Regional Electric Power Plant operating on coal dust and high-sulfur fuel oil. The latest cleaning equipment installed for cleaning the outer heating surfaces in the boilers is a sonic unit utilizing the action of shock waves and a high-velocity jet of the products of explosion of a mixture of air and natural gas. The installation includes two explosion chambers, ignition units and gas-air mixers. The explosive chamber is a tube 426 mm in diameter and about 15 m long. After this chamber has been filled with the explosive gas-air mixture, a spark plug ignites the mixture. The voltage supply to the spark plug is controllable by a thyristorized timing relay so that the frequency and force of the explosions can be regulated. Valves and manometers control the air and gas flowrates. Figure 1.
[118-6610]

EXPERIENCE IN CONVERTING 220/127-V POWER GRIDS TO 380/220 V IN MOSCOW

Moscow ENERGETIK in Russian No 4, Apr 81 pp 19-20

PLETNEV, L. F., engineer

[Abstract] Since 1950 the communal facilities of new housing developments near Moscow have been using electric services on 380/220 V. The 220/127-V power grids in the city are now being converted to 380/220 V. Old transformers (GOST 401-41) are being replaced with new units (GOST 12022-76) that have lower losses. This will reduce power losses by 6000 W per transformer and increase the power of the transformer point by an average of 30% since 180-320 kVA transformers will be replaced with 250-400 kVA units. Reduced losses will pay for the new transformers within two years. Specialized teams were organized for the work in 1975-1976, converting more than 400 transformer points each year. All the work of conversion is being handled by Mosenergo SSSR, up to and including replacement of meters. Residents are responsible for replacing light bulbs and heating elements, as well as providing step-down transformers for appliances such as refrigerators that do not have built-in transformers.
[118-6610]

UDC 662.997:537.22(088.8)

EXPERIMENTAL STUDY OF A PARABOLOCYLINDRICAL SOLAR CONCENTRATOR WITH TUBULAR HEAT EXCHANGER

Tashkent GELIOTEKHNIKA in Russian No 6, 1980 pp 66-68 manuscript received 25 Aug 78

MARKMAN, M. A., KOLOMOYETS, N. V., SIMANOVSKIY, L. M., SHMATOK, Yu. I. and ZAKHAROVA, O. P., All-Union Scientific Research Institute of Current Sources

[Abstract] Experimental studies are done on a parabolocylindrical solar concentrator made of sheet metal with a tubular heat exchanger as a source of thermal energy with temperature up to 300°C. The material of the concentrator is polished anodized aluminum sheet 1 mm thick with overall dimensions of 2000x1000 mm. The parabolic cylindrical surface is produced by elastic deformation with a very small angular error. The apex angle is 180°, and the focal length is 400 mm. The heat exchanger is made in the form of a blackened metal tube 22 mm in diameter placed inside a glass tube with diameter of 40 mm (the envelope of a fluorescent lamp). The heat exchanger was placed on the focal axis of the concentrator. The annulus between the metal and glass tubes was open to the atmosphere. The focusing properties of the concentrator were determined, as well as the efficiency of the concentrator with heat exchanger as a function of temperature. Figure 1, references: 1 Russian.
[128-6610]

UDC 681.184:62-4

ADAPTIVE ELECTROMAGNETIC DEVICE FOR ORIENTATION OF NONMAGNETIC FLAT PARTS

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 5, May 81 p 37

KOYRO, V. M., engineer and ZHABOTINSKIY, Yu. D., engineer

[Abstract] An adaptive electromagnetic device has been developed for orienting flat leaf-type parts made of nonmagnetic electrical conductor materials, specifically for their final orientation after a preliminary orientation in a vibrating hopper. Its principle of operation is based on two possible electrodynamic analogs, with the force action of the electromagnetic field being either stronger on one end of a part than on the rest of it or stronger on both ends of a part than on its middle. The device consists of an a.c. generator, a switch, two electromagnets side by side with aligned air gaps through which parts move, an incoming tray and an outgoing tray, and a movable detent for accommodating parts of various sizes. The two electromagnets operate sequentially, each with an on-hold-off cycle; to detect and then orient a part before discharging it. Parts corresponding to the second analog require also a discriminator, a set of inductive transducers under the incoming tray, for determining the type and the position of a part. The necessary and sufficient number of transducers in such a discriminator set can be established by the "divide and rule" method, and their proper places can be determined through graphical projection and superposition. The industrial prototype of this device can handle parts weighing up to 5 g at a rate of 60 parts/min, for up to 400 h before failure. Figures 3, references: 4 Russian.
[149-2415]

UDC 007.52:061.4

DRIVE FOR AN ASSEMBLY-LINE ROBOT

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 5, May 81 pp 35-37

YEGOROV, I. N., candidate of technical sciences, KOBZEV, A. A., candidate of technical sciences, and KRAVCHENKO, V. N., engineer

[Abstract] A promising trend in automation of assembly operations is the use of industrial robots, assembly of parts of the pin-and-hole type being the simplest and most preferable. Here the performance of a robot in such an assembly process is analyzed, assuming an oscillatory motion along two axes for hole location and a subsequent pin insertion. The drive for such a robot, usually a stepper motor, must be controlled accordingly. It responds to control pulses but must also include means for irreversible self-braking between pulses. The stepper motor described here is an ShD-5 with 1.5° steps and a 1.2 kHz pickup frequency. The lead screw has a pitch of 5 mm, with a 5 μm discretization. A robot with this drive can handle parts weighing 5-10 kg with pins 10-100 mm in diameter, ensuring a minimum clearance of 20 μm between assembled parts. Figures 2, references: 5 Russian.
[149-2415]

UDC 621.511.534.8:62-229.72

PNEUMOACOUSTIC SENSING DEVICES FOR INDUSTRIAL ROBOTS

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 5, May 81 pp 34-35

SHEL'PYAKOV, A. N., engineer, and ISUPOV, G. P., candidate of technical sciences

[Abstract] The elements of pneumoacoustic devices are pneumoacoustic generators (resonating sirens, wedges, wedge-resonators), acoustopneumatic converters (with turbulized laminar jet or with turbulent jet), concentrators of acoustic waves (reflectors or lenses), and secondary converters (functional signal transducers and converters from one form of energy to another). Sensing devices for industrial robots can be built with these elements of whatever appropriate type so as to meet the basic three requirements of miniaturization, economy and simplicity. An advantage here is that compressed air serves as the single source of energy for all operations of an industrial robot, including location and grip of parts within the assigned zone along the assembly line. Figures 4, references 8: 6 Russian, 2 Western.
[149-2415]

UDC 007.52:681.2

AUTOMATIC MANIPULATORS IN INSTRUMENT MANUFACTURE

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 5, May 81 pp 31-33

GOLOTO, I. D., candidate of technical sciences, MITYASHIN, I. P., candidate of technical sciences, and BOROVSKIY, M. G., engineer

[Abstract] The role of automatic manipulators in instrument manufacture is discussed and progress in their industrial use for large-scale production is reviewed. Automatic manipulators with programmable numeric control and pneumatic or electromechanical drives have already been installed in assembly lines for such products as clockworks and household-refrigerator temperature regulators, their use in the production of printed circuits and sound recording controls is considered. These manipulators, existing and proposed PR (Industrial Robot) models as well as proposed PMR models, with hand and wrist provide 2-4 or 5-6 degrees of freedom, depending on the application, and which system of coordinates they operate. The smaller models with 2-4 degrees of freedom have a mass carrying capacity ranging from 0.2 to 1 kg and a positioning error from ±0.03 to ±0.25 mm, they weigh from 1.5 to 80 kg. The larger models with 5 degrees of freedom have a mass carrying capacity from 1.6 to 6.3 kg and a positioning error within ±0.5 mm, they weigh from 100 to 150 kg. The largest "Universal-5" with 6 degrees of freedom in a cylindrical system of coordinates has a mass carrying capacity of 5 kg and a positioning error within ±1 mm, it weighs 610 kg. There is now a growing demand for automatic manipulators designed to perform welding and painting operations in the production of computer components. Figures 3, tables 2.
[149-2415]

UDC 620.178.53:621.359.48:621.38

USE OF POLYNOMIAL-TYPE FILTERS FOR CONTROLLING THE VIBRATION SPECTRUM

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 5, May 81 p 24

[Annotation of an article deposited at the Central Scientific Research Institute of Technical and Economic Information on Instrument Design (No 1488)]

KLEYBANOV, S. B., engineer, and OGANESYAN, M. A., engineer, Institute of Control Problems, Moscow

[Abstract] For vibration testing of various devices it is necessary to generate a spectrum of random vibrations which most closely approximates the real service conditions. This is achieved by transmitting the signal from the generator of random processes to the vibration stand through a filter. Here a polynomial-type

filter is proposed for this purpose, as a more economical alternative to a conventional set of narrow-band filters with weighting coefficients and a common adder. Actually, two identical such filters are needed in parallel with a reference filter, each consisting of N elementary sections with tunable coefficients. A quadratic filter response parameter serves as the optimality criterion, to be minimized with the vector of coefficients according to an iterative algorithm of steepest descent. As long as the characteristics of the vibration stand are not known, the gradient of the target function cannot be calculated directly from observable signals and a third identical filter must be inserted for tuning. The entire procedure has been programmed in FORTRAN-4 and checked on filters with N = 30 sections and 0.00025 s time delays for vibration testing in the 0-2000 Hz range. Figures 2, references: 2 Russian.
[149-2415]

UDC 658.011.56:62-21-181.4

AUTOMATING THE FABRICATION OF SMALL CHASSIS PARTS

Moscow STANKI I INSTRUMENT in Russian No 3, Mar 81 pp 3-5

KRUGLOV, V. A.

[Abstract] Chassis parts smaller than 250x250x250 mm^2 are most productively fabricated in milling machines with programmable numeric control or in universal machines with automatic interchange of cutting tools. Such parts include (in the order of decreasing production volume) hulls, lids, frames, brackets and boards. Most of these parts (74%) are made of aluminum alloys, the rest of stainless steel, magnesium alloys, cast steel, or cast brass. The equipment and the controls are designed and must be selected from available models to yield the necessary machining precision in each specific case, within appropriate tolerance limits, subject to inspection for quality control. It has been established experimentally which dimensions and geometrical relations are critical in fabricating a part, typically with holes, to design specifications and the precision of which dimension or geometrical relation will be determined by the precision of the tool setting or the precision of other items in the machine setup. A thorough evaluation of both functional and precision parameters is necessary, to ensure efficient and reliable production of parts, which furthermore requires an extensive experimental and theoretical investigation of available machine tool models. Tables 3, references: 6 Russian.
[148-2415]

UDC 621.9.077-52:681.3.06

MICROPROGRAMMING IN THE CONTROL SYSTEM OF AN AUTOMATIC MANIPULATOR

Moscow STANKI I INSTRUMENT in Russian No 3, Mar 81 pp 2-3

GORBUNOV, V. V. and ROSSOSHANSKIY, N. G.

[Abstract] The automatic manipulator model SM40Ts4011 with a 40 kg lifting capacity is series produced by the Krasnodarsk Machine Tool Manufacturing Association, mainly for semiautomatic lathe operation. Its movements along the horizontal axis, along the vertical axis and around the vertical axis are controlled by a cycling system through a set of plugboards. The cycle of operations is broken down into four repeating microcycles, with a microprogram assigned to each: M1 picking a blank from the stock bin, M2 loading the machine tool with the blank, M3 unloading the machine tool after cutting operation, M4 dropping the finished part into the storage bin. The algorithms of these microcycles are implemented by servomechanisms and the sequences M1-M2-M3-M4 or M3-M4-M1-M2 are established according to a main program put in through a 15-stroke counter-distributor with the necessary command system. The hardware includes, in addition to a starting trigger, also a decoder before the microprogram plugboards and an amplifier behind the microprogram plugboards, with a servomechanism and feedback transducers in the control loop. Microprogramming of the manipulator operation in this manner has reduced the number of necessary relays by 30% and improved the resolving power of the system, also reduced the size of the plugboards and simplified the entire programming. Figures 2, references: 3 Russian.
[148-2415]

UDC 621.9.077-52

EXPERIMENTAL STUDY OF THE MOVEMENTS OF AN AUTOMATIC MANIPULATOR

Moscow STANKI I INSTRUMENT in Russian No 3, Mar 81 pp 1-2

PANOV, A. A.

[Abstract] A computer program has been developed for mathematical simulation of an automatic manipulator driven by a stepper motor rigidly coupled to a hydraulic amplifier. In the simplified dynamic model this manipulator appears as a lumped mass whose location in a rectangular system of coordinates is uniquely defined by two degrees of freedom. The manipulator carriage has a vertical plane of symmetry and transverse dimensions much smaller than its length so that its motion, on rollers driven by gear couples, can be regarded approximately as translational. The stepper motor responds to pulses coming from a programmable numeric control system. The

differential equation of motion for such an automatic manipulator is derived from those describing the behavior of its mechanical components,especially the stepper motor and the hydraulic amplifier, also in the lumped-mass approximation and assuming a laminar leakage of fluid proportional to pressure differentials. Included are the equations of torsional vibrations during linear motion of the manipulator. This computer program provides information about transients and about the dependence of the drive precision on various parameters. The algorithm is designed for evaluating the accuracy of manipulator positioning under various loads and for analyzing the dynamics of the control system, it can also be extended to automatic manipulators with adaptive control. Figures 2, references: 2 Russian.
[148-2415]

UDC 007.52-529.003.13:621.9.077

EFFECTIVE USE OF AUTOMATIC MANIPULATORS FOR MACHINING PARTS IN SERIES PRODUCTION

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 2, Feb 81
pp 20-21

BARYSHNIKOV, A. Ya., candidate of technical sciences

[Abstract] An economic analysis is made to establish ways in which the effectiveness of programmed automatic manipulators in series production can be improved. The author considers a metal cutting process with programmable digital control, where the introduction of automatic manipulators should reduce the labor cost and the conditionally fixed cost of a piece because of a higher production volume. Calculations of the annual economic effect due to reduction of the manufacturing cost, including also its conditionally variable part as well as manipulator operating and maintenance costs, reveal this effect will increase with a change from a 2-shift to a 3-shift work schedule. A typical automatic manipulator costing 30,000 rubles will annually save 24,500 rubles when working three shifts and lose 4,800 rubles when working two shifts.
[144-2415]

UDC Δ 62-229.7:667.661

MANIPULATOR FOR SEMIAUTOMATIC APPLICATION OF VARNISH-PAINT COATINGS

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 5, May 81
pp 31-32

MAKAROV, I. N., candidate of technical sciences, and MITINA, M. S., engineer

[Abstract] Equipment including a manipulator has been developed for semiautomatic varnish-paint coating of flat parts in an extrusion chamber. The equipment

includes also a table for the parts, paint application rollers, tracks and track supports, and a manipulator control panel. A special hydraulic filter cleans the air of dust and prevents contamination of the separators as well as of the inside surface of the extrusion chamber. The table is movable with in-position locking. The pneumatically controlled manipulator has a gantry which moves on tracks parallel to the "mirror" plane of the extrusion chamber, while a carriage with a paint gun moves on tracks perpendicular to that plane. The productivity of this equipment is 200 m^2/h, and it produces a much more uniform coating than manual application. Figures 2.
[145-2415]

UDC / 62-229.7

AUTOMATIC MANIPULATOR MODEL UM160F2 FOR METAL CUTTING MACHINE TOOLS

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 5, May 81 pp 28-30

TSARENKO, V. I., engineer, ZHITOMIRSKIY, S. V., engineer, and NIKOLAYEV, A. A., engineer

[Abstract] The automatic manipulator Model UM160F2 has been developed at the Experimental Scientific Research Institute of Metal Cutting Machine Tools for loading horizontal machine tools. The test model is now operating on a lathe for turning shafts in the Moscow Electromechanical Plant "Dinamo". It consists of an electrical supply system, programmable digital control, a kinematic linkage, a hydraulic drive system, and a safety system. Four structures of the technological complex including this automatic manipulator are possible: sequential parts processing according to a flow chart, independent operation of individual machine tools, and a hybrid structure with either parallel or sequential operation of equipment. Here are shown six variants of parts transfer from one machine tool to the next: three schemes where this is done by a conveyor and three schemes where this is done by the automatic manipulator, storage between machine tools also being provided in one of the latter three schemes.
[145-2415]

UDC 621.9.06-52:658.527

AUTOMATIC TRACKING OF THE MOVEMENT OF PRODUCT LOTS

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 4, Apr 81 pp 10-12

MARGOLIN, Sh. M., candidate of technical sciences, and GUROV, A. S., engineer

[Abstract] Production flow tracking systems are used where installation of many sensors would not be feasible, as in inaccessible locations. Such systems, built with "Logika-T" elements, have been installed on three assembly lines in a pipe and bimetal rod production plant. Here the tracking of the movement of production lots is described, the system being based on flip-flops built with T-102 logic elements and including transistorized delay lines on T-302 logic elements. Shift registers are used for storing the information and transmitting it along the production line. Two such shift registers are shown, a 4-position 1-cycle paraphasal one on "Logika-I" JK flip-flops and a parallel one, also a complete information transmitting system. Figures 4.

[142-2415]

UDC Δ 62-523: Δ 621.791.039

CONTROL SYSTEM WITH HYDRAULIC FEEDBACK FOR AUTOMATIC MANIPULATORS

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 4, Apr 81 pp 4-7

PETRAKOV, G. N., engineer and LEVCHUK, D. M., candidate of technical sciences

[Abstract] The cost of automatic manipulators with an electric drive and an electronic control system increases as their versatility increases. Their functional and technological capabilities are not always realizable, moreover, especially in large-scale production. An economically competitive alternative is hydraulic positioning systems with digital control. The authors describe a single-coordinate system with hydraulic volume feedback. It consists of a program carrier which sends an electric signal to an electromagnet driving a hydraulic distributor, a volume master-comparator, a holding slide valve, a pump with a power drive, an actuator and the operator. A distinctive feature of this positioning system is that the feedback circuit puts out a hydraulic signal which controls the holding valve directly, this signal building up at a rate proportional to the actuator velocity. The operation of this system is explained with the aid of a schematic diagram showing the flow of signals (electric and hydraulic) and a structural diagram showing the layout of components. One important design parameter is the magnitude of the positioning displacement of the actuator, which depends on geometrical factors and

on the displacement necessary for formation of a hydraulic signal that will trigger the valve. Another important design parameter is the ratio of plunger area to valve face area. The two important performance characteristics are accuracy and reliability, the former easily evaluated on the basis of a conventional error accumulation analysis and the latter determined by the quality of welds and precision of assembly. Figures 2.
[142-2415]

UDC 621.73.007.52

DEVICES FOR CONTROL OF FORGING PRESSES AND INDUSTRIAL OPERATIONS

Moscow VESTNIK MASHINOSTROYENIYA in Russian No 4, Apr 81 pp 63-64

GOLUBOV, A. V.

[Abstract] Automation of forging presses with programmable control is one way to improve the efficiency of small-scale and batch production. The Taganrog Planning and Design Technological Institute of Forging Press Robots has developed a general-purpose 32-input microprocessor for signals from transmitters of external information according to a control algorithm,typical applications being thermoplastic extrusion, hole punching and plate bending. Also a 16-channel programmable electronic command system with direct-access storage has been developed for technological complexes with crank-drive presses. Other devices include controls for industrial operations as well as terminal equipment, these being highly standardized reliable devices very easily bebugged. At the same time, a large assortment of minicomputers, microprocessors and electronic storage devices is already available on the market. Combining these resources, the multiprogram numeric control system "Elektronika NTs-31" has been constructed by enterprises of the USSR Ministry of Instrument Automation and Control Systems for use in the plate bending process. Its advantages are a large number of bends per program and a quick readjustment from one product item to another, but the functional redundancy of the system for tracking information from a large number of transmitters and maintaining the necessary cutter speed along the edges makes it almost impossible to operate along two coordinates simulatneously and thus lowers the productivity. Microprocessors and minicomputers can be used not only for processing numeric information about a machine tool but also for processing logical data. A microcontroller is now being developed at the Taganrog Institute which will replace relay-contact system containing more than 40 relays.
[147-2415]

UDC 621.73.007.52

PRESENT STATUS OF AND OUTLOOK FOR INTRODUCTION OF AUTOMATING MANIPULATORS (INDUSTRIAL ROBOTS) INTO THE FORGING-STAMPING PRODUCTION PROCESS

Moscow VESTNIK MASHINOSTROYENIYA in Russian No 4, Apr 81 pp 60-63

KHMEL'NITSKIY, M. N., engineer

[Abstract] The introduction of industrial robots into the forging-stamping production process must be viewed from three standpoints. In social terms it is a relief from an increasing volume of monotonous operations and thus an improvement of the working conditions. In economic terms it is a shift from labor cost, which increases with increasing complexity of operations while the cost of automation decreases. In technical terms, robots with programmable control offer a much wider range of functional capabilities than do conventional means of automation. In preparation for the tasks of the Eleventh Five-Year Plan, studies on this subject have been done at the Taganrog Planning and Design Technological Institute of Forging Press Robots. Documentation has been prepared for building seven automatic complexes and seven modifications of automatic manipulators with manual control using pneumatic, hydraulic, or electromechanical drives. Series production of some of these models is being organized at several Soyuzkuzmash enterprises. Development and introduction of operator-controlled manipulators is an important item on the Institute's agenda. Another one is development and introduction of controls and electronic devices for forging presses such as relay-contact, contactless, and cyclic systems with rigid or free programmable logic, also computerized preset numerical control. It has been found that various forging presses can be operated with the same type of preset numerical control, with only occasional functional redundancy. To this must be added development and introduction of appropriate special-purpose instruments for measurement and diagnosis. Automated technological complexes are already in operation in the Ryazansk Tyazhpressmash Plant, the Kursk Schetmash Plant, and Sal'sk Soyuzkuzmash Plant, the Taganrog Mechanical Works and the Rostov Krasnyy Aksay Plant.
[147-2415]

UDC 621.007.52

EXPERIMENTALLY DETERMINING THE FRICTIONAL FORCES IN KINEMATIC PAIRS OF AUTOMATIC MANIPULATORS (INDUSTRIAL ROBOTS)

Moscow VESTNIK MASHINOSTROYENIYA in Russian No 4, Apr 81 pp 27-29

VARENTSOV, V. V., candidate of technical sciences, KRAVCHENKO, N. F., candidate of technical sciences, POLYAKOV, Yu. B., engineer, and POTEYEV, M. I., candidate of technical sciences

[Abstract] A method is described by which the actual frictional forces in kinematic pairs of pneumatically driven automatic manipulators can be determined experimentally. Data for the kinematic equations of motion are obtained by high-speed photography and data for the dynamic equations are obtained from measurement of the pressures in the cylinder spaces. The frictional forces are then calculated from these equations. The method was tested on an RF-201M industrial robot, in the simple case of a single travel: radial movement of the arm. Calculations, made with the aid of a computer, reveal that the friction in such kinematic pairs depends on both orthogonal components of the velocity and is of the boundary type, characterized by only a few contact spots. In the range of low velocities the adhesion component of this friction decrease while its hysteresis component remains constant with increasing velocity. Figures 4, references: 2 Russian.
[147-2415]

UDC 62-522.007.52

IMPROVING THE HYDRAULIC-PNEUMATIC DRIVES OF INDUSTRIAL ROBOTS

Moscow VESTNIK MASHINOSTROYENIYA in Russian No 3, Mar 81 pp 26-29

VODOP'YAN, P. O., engineer

[Abstract] Industrial robots, both in the Soviet Union and abroad, operate with three types of hydraulic drives: 1) electrohydraulic closed tracking drives with displacement servomechanisms and feedback using servomotors and torque motors, 2) electrohydraulic open digital drives with hydraulic displacement servomechanisms without displacement checking and using stepper motors, 3) hydraulic positioning drives with cyclic programmed control. The types of pneumatic drives are analogous in principle. Many models of drive components already have been and still are being developed, the aim being higher pressure and torque ratings, better performance, simpler design, smaller size and lower cost. Important factors are optimization of the pump system, preferably with remote control, and the layout of braking valves. Further improvements are being achieved through the use of hydraulic

distributors with remote control. Cost analysis shows that electric drives cannot compete with hydraulic ones. Figures 2.
[146-2415]

UDC 62-85.007.52

INDUSTRIAL ROBOT WITH SMOOTH BRAKING OF THE PNEUMATIC SERVOMECHANISM

Moscow VESTNIK MASHINOSTROYENIYA in Russian No 3, Mar 81 pp 5-8

GRADETSKIY, V. G., candidate of technical sciences, and PAROY, A. A., candidate of technical sciences

[Abstract] The versatility of industrial robots can be increased by the use of primary transducers which measure various forms of radiation identifying the object characteristics. These transducers impose severe requirements on the dynamic characteristics of the drive mechanisms, particularly smoothness of motion toward the end of a travel with the minimum braking time. Pneumatic drives are the simplest and most widely used ones. Excellent braking characteristics can be achieved here by design only, without special braking devices, namely by providing an extra volume in the active cylinder space or in the exhaust space, or a throttle at the exit from the exhaust space. The performance in each case is evaluated on the basis of equations of motion describing the braking process. These equations have been solved with the aid of a digital computer for wide ranges of process and system parameters, the results indicating how the coordinate of the piston position, the pressure in the active space, and the pressure in the idle space depend on the transmitting capacity and the relative load level during the acceleration period and on the characteristics of the various system components including the air. Usually braking is effected in two stages, first increasing the deceleration and then maintaining it constant. The braking process can be optimized, by design, on the basis of the solution to equations describing the first stage. Figures 3, references 5 Russian.
[146-2415]

UDC 621.791:621.165.5

TECHNOLOGY OF PRODUCING CUSTOM-BUILT WELDED TURBINE RUNNERS

Moscow ENERGOMASHINOSTROYENIYE in Russian No 5, May 81 pp 23-26

NIKITIN, Yu. M., candidate of technical sciences, NAZARUK, V. B., engineer, BRAYNIN, V. N., engineer, IVANOVA, I. G., engineer, and BUGAYETS, A. A., engineer

[Abstract] With the metallurgical base already available, experience in producing turbine runners weighing 30-80 metric tons was utilized in developing a technology

for welded runners weighing 90-200 metric tons for the low-pressure stage of K-1200-240 steam turbines. Various grades of steel were considered, grade 20KhN2MFA(Sh) being finally recommended because of its satisfactory weldability and high resistance to brittle fracture. Cast ingots are to be forged, then annealed as a counterflocculation measure, twice quenched and, finally, tempered at 630-640°C. The assembly of nine runner segments is vertical, with the curvature of a 10 m long runner axis not exceeding 1 mm. Welding is done automatically with Sv-08KhN2GMYu wire and AN-17M flux in an argon arc. Stresses at the root of the seam are relieved by underboring. The runners thus produced meet all technical specifications. Figures 2, tables 3, references 7: 5 Russian, 2 Western.
[137-2415]

UDC Δ 621.7.077.002.5

INTRODUCTION OF TECHNOLOGICAL COMPLEXES WITH AUTOMATIC MANIPULATORS INTO THE STAMPING PROCESS

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 1, Jan 81 pp 22-23

KOZLOV, A. A., engineer

[Abstract] A technological complex for stamping parts from flat steel blanks in three or fewer operations has been in service in one Leningrad plant since 1979. It consists of three 40-ton presses, five RF-201M automatic manipulators, a loading device, a control panel and equipment for producing six kinds of parts weighing up to 200 g. The automatic manipulators are of the latest design, with two hands and electromagnetic clamps, with transucers at the pivots and on the hands, and control logic coupled to external transducers. Three of them stand directly before the presses for the stamping operations, the two others stand between presses for the transport operations. Their productivity is still low, not more then 11 cycles/min or correspondingly a total of 660 parts/min, because the dampers at the pivots still fail quite often causing shutdowns. Further developments and improvements should include a higher productivity with 15-25 cycles/min for parts weighing 1 kg - 200 g correspondingly, unit-head construction with 2-3 degrees of mobility, and auxiliary equipment for special-purpose stamping jobs.
[143-2415]

UDC 532.516:621.822

INVESTIGATION AND OPTIMIZATION OF RADIAL GAS-STATIC BEARINGS WITH LONGITUDINAL GROOVES BASED ON ANGULAR RIGIDITY

Moscow MASHINOVEDENIYE in Russian No 2, Mar-Apr 81 pp 100-107
manuscript received 5 Mar 80

TABACHNIKOV, Yu. B., SHEVCHENKO, A. V. and STEPANCHUK, V. I., Moscow and Vinnitsa

[Abstract] Gas-static bearings have become popular as supports for precision mills and instruments. It is often necessary to maintain a preset accuracy of rotary axis position under conditions of slowly fluctuating asymmetrical load with rigid structural constraints on shaft length. The parameters which describe resistance of the outer throttle and geometry of the longitudinal grooves are optimized for the most interesting structural designs of cylindrical gas-static supports in a non-isotropic field. A comparison of the results of optimization obtained on the basis of criteria considering the dimensionless characteristics of supports, narrows down the range of all imaginable designs of bearings. The choice of a support for an actual subassembly is not merely a selection of a support for its dimensionless characteristics. Technological effectiveness becomes important: strict tolerances on gap, slit width, groove depth, etc. In some cases, a bearing with longitudinal grooves and no external throttle will be preferable to any non-profiled support or even a doubled bearing with blow-by slits. Figures 3, references 6 Russian.
[87-8617]

UDC 621.01

THREE-DIMENSIONAL CHARACTERISTICS OF FREIGHT MANIPULATORS

Moscow MASHINOVEDENIYE in Russian No 2, Mar-Apr 81, pp 60-64
manuscript received 9 Jul 80

PYNDAK, V. I., Volgograd

[Abstract] Hoisting apparatus which employs three-dimensional mechanisms has zones of action which can reveal patterns of motion within the space of the actuating unit of various types of manipulators. They can be studied on the basis of the Vinogradov method of volumes, which provides general estimates of the kinematic properties of manipulators. A telescopic three-dimensional mechanism mounted on a rotating base, driven by an additional power cylinder, has wide kinematic possibilities. The freight manipulator in this design operates on a self-propelled tractor chassis. Matrices are given which offer data on three-dimensional mobility of various manipulators based on the structure of the zone of action of mobile hinge-and-lever systems. The tabular data can be used to determine the dimensions of any space. Figures 4, references 9 Russian.
[85-8617]

UDC 621.80:007.52

STABILITY OF AUTOMATED MANIPULATOR CONTROL SYSTEMS

Moscow MASHINOVEDENIYE in Russian No 2, Mar-Apr 81 pp 53-59
manuscript received 21 Jul 80

STOLIN, Yu. V. and TYVES, L. I., Moscow

[Abstract] The increased precision of reproducing program-selected grip positions of an automatic manipulator requires feedback sensors for the control system. Speed must be increased by installing drive motors with kinematic transmissions that connect the drive motors to the arm elements. The dynamics of simplified models of manipulators having two degrees of freedom and a control system constructed according to a feedback sensor design are examined. Coordinate matrices are utilized to describe the partial transmission functions of the kinematic circuit structure. The effect of using criss cross feedback on the properties of the control system of automatic manipulators is demonstrated in a dynamic model. Figures 4, references 3 Russian.
[85-8617]

UDC 621.313.323.001.24

DETERMINING THE DESIGN PARAMETERS OF SYNCHRONOUS MOTORS WITH A MASSIVE ROTOR

Moscow PROMYSHLENNAYA ENERGETIKA in Russian No 1, Jan 81 pp 27-31

FEDOROV, A. A., doctor of technical sciences, GAMAZIN, S. I., candidate of technical sciences, SADYKBEKOV, T. A. and POLTAVTSEV, O. V., engineers, Moscow Power Engineering Institute

[Abstract] An algorithm is proposed for calculating the main parameters and starting characteristics of synchronous motors with massive smooth rotor from catalog data. It is shown that the damping system of the motor can be represented in a substitution circuit by an equivalent tank in which the inductive reactance of dissipation and the resistance depend on the slip of the rotor. The proposed method of calculating the parameters of the substitution circuit and the starting characteristics utilizes only the most well known catalog data for the motor. The calculated starting torque characteristic differs by no more than 3% from the manufacturing data. Figures 4, references 6 Russian.
[117-6610]

UDC 621.833.6(088.8)

NEW GEAR MECHANISMS

Moscow MASHINOSTROITEL' in Russian No 3, Mar 81 p 16

SABLIN, V. P.

[Abstract] The article describes some new designs of planetary mangle-gear mechanisms (patent application No 2730959). The proposed devices have a variety of kinematic and functional capabilities, providing different angles of turn of the cage between two pauses. These gear mechanisms can be most effectively used in facilities for automation of production processes. Kinematic diagrams are given of mechanisms that convert reciprocating rotary motion to reciprocating rotary motion with pauses and continuous rotary motion to interrupted rotary motion. Diagrams are also given of rack-and-pinion mangle-gear mechanisms for converting rotary reciprocating motion to interrupted reciprocating rotary motion of a driven link with stopping in the end positions (patent application No 2683948). Figures 5.
[116-6610]

UDC 621.744.2:674

RAPID-CHANGE PATTERN-MAKING EQUIPMENT

Moscow MASHINOSTROITEL' in Russian No 3, Mar 81 p 18

ANDREYEV, A. M.

[Abstract] A pattern holder is proposed that consists of cast iron plates with interchangeable inserts to which the casting pattern is fastened. The patterns are made of "lignamon", a material developed at the Institute of Wood Chemistry of the Latvian Academy of Sciences. This pattern-making material takes a high polish and can withstand 12,000-14,000 machine molding cycles. With the new pattern holder, changing takes only 10-15 minutes.
[116-6610]

UDC 621.81:621.317.7.001

DETERMINING THE OPTIMUM DIMENSIONS OF TWO-STAGE SPUR-GEAR SPEED REDUCERS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: MASHINOSTROYENIYE in Russian No 1, Jan 81 pp 20-23 manuscript received 5 Jul 79

GALIBEY, N. I., candidate of technical sciences, docent, and MAU, G. A., lecturer

[Abstract] The design of gearboxes involves determination of the optimum version of the final design. The conventional method of calculation with respect to conditions of operability (contact or bending strength) does not uniquely define all the major parameters of a gear transmission. The difficulties increase in proportion to the number of gears included in the transmission, and the designer is forced to use makeshift measures to assign a large number of unknown parameters. The resultant design cannot be called optimum. The authors find the major conditions for determining the optimum version of a two-stage spur-gear speed reducer, and derive mathematical relations for these conditions that are suitable for computer solution. Figures 2.
[125-6610]

UDC 621.01

INSTANTANEOUS DEGREE OF MOBILITY OF A MANIPULATOR

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: MASHINOSTROYENIYE in Russian No 1, Jan 81 pp 55-58 manuscript received 28 Mar 79

KARPOVICH, S. Ye., candidate of technical sciences, senior instructor

[Abstract] The instantaneous degree of mobility of a manipulator at different points of the working zone is determined by a method based on the theorem of existence of a system of implicit functions [F. L. Litvin, S. Ye. Karpovich, "Kinematic Analysis of Manipulators", in: "Teoriya mekhanizmov i mashin", Materialy pervogo Vsesoyuznogo s"yezda po teorii mekhanizmov i mashin (Theory of Mechanisms and Machines, Materials of the First All-Union Congress on the Theory of Mechanisms and Machines), Alma-Ata, 1977]. The author has used this technique previously in studying the particular positions of the links of lever mechanisms and determining the conditions of existence of a crank. In this paper the method is applied to a manipulator of general form containing seven links connected by six rotating kinematic pairs. Figures 2, references 3 Russian.
[125-6610]

TURBINE AND ENGINE DESIGN

UDC 621.438.621.43.056

BURNOUT OF THE FUEL MIXTURE IN COMBUSTION CHAMBERS OF GAS TURBINE ENGINES

Moscow TEPLOENERGETIKA in Russian No 6, Jun 81 pp 66-69

SAMOYLOV, I. B., engineer, MURASHOV, A. F. (deceased), candidate of technical sciences, OZEROV, Ye. A., engineer, and SOKOLOV, Ye. G., engineer, Institute of Chemical Physics, USSR Academy of Sciences

[Abstract] The burndown of CO after burnout of a hydrocarbon fuel in combustion chambers of gas turbine engines appears to involve, at least at the tip of the open flame, oxidation of CO and H_2 according to some kinetic scheme. This hypothesis was verified in an experimental study with diesel fuel and air injection in a model combustion chamber including a vane-type turbulizer and a transition cone. The chamber inlet conditions were pressure $p = 0.4$ MPa, temperature $T = 500$ K, fuel rate $G = 4$ kg/s. Ionization profiles across the chamber at three characteristic sections, based on the results of gas analysis in these sections, and radiation spectrograms taken at the outlet nozzle indicate a combustion pattern inside the chamber analogous to the one in an open-flame model, with a burndown of CO and H_2 at the chamber axis over almost the entire length. It is thus possible to optimize the utilization of combustion products from rich mixtures for stabilizing a flame in a stream with a high percentage of excess air. This is, indeed, the trend in development of better combustion chambers including stepwise fuel injection. The limiting factor here is usually the mixing process rather than the kinetics of chemical reactions. Further confirmation of the roles of CO and H_2 in the stabilization process could lead to significant design simplifications. Figures 6, table 1, references 10: 6 Russian, 4 Western.
[132-2415]

UDC 621.311.18

EXPERIENCE IN ADJUSTMENT OF PILOT SPECIMENS OF VACUUM SURFACE PREHEATERS FOR A K-500-240 TURBINE

Moscow TEPLOENERGETIKA in Russian No 6, Jun 81 pp 34-37

BELOUSOV, M. P., engineer, PERMYAKOV, V. A., candidate of technical sciences, YUSHKOV, G. I., engineer, PODGOROCHNYY, P. I., engineer, and BELYAKOV, V. Ya., engineer, Scientific-Industrial Association, Central Institute of Boilers and Turbines, Reftinskaya State Regional Electric Power Plant, Planning Department, "Krasnyy Kotel'shchik"

[Abstract] Regenerative vacuum surface preheaters for low-pressure steam turbines often perform unsatisfactorily, and experience in service has revealed that one main cause is accumulation of air or noncondensable gases in the interpiping space. Countermeasures are required such as keeping any condensate of the heating stream and of the leakage steam from the air drawoff pipe, reducing the hydraulic drag at the steam inlet to the preheater, a better location of that inlet, and a better routing of the steam flow in the interpiping space. Pilot specimens of PN-800-29-IIINZh (OND-1) and PN-800-29-IINZh (PND-2) preheaters for K-500-240 turbines manufactured at the Khar'kov Tractor Plant were tested with a new air drawoff system, an additional important feature being an air cooler installed in the preheater. Temperature measurements, with attendant pressure (rarefaction) measurements at the steam inlet to the preheater, established an only 3°C underheat of the feed water at a flow rate of 1146 t/h after a transient period of 1 h. Figures 2, table 1, references 7 Russian.
[132-2415]

UDC 621.165.001.2

OPTIMAL SHAPING OF THE GUIDE VANES FOR STEAM POWER TURBINES

Moscow TEPLOENERGETIKA in Russian No 4, Apr 81 pp 63-65

BILAN, V. N. (dissertational), engineer, SHUBENKO-SHUBIN, L. A., academician (UkSSR Academy of Sciences), STOYANOV, F. A., candidate of technical sciences, and ROGOVOY, M. I., engineer, Institute of Problems in Machine Design, UkSSR Academy of Sciences, Planning Department, Tomsk Metal Plant

[Abstract] Optimal design of the vane stage for steam turbines, a problem in nonlinear mathematical programming, is treated from a systems standpoint with a single hierarchical mathematical model for the vanes, the baffle and its rim. The total power loss associated with streamlining of the vanes is the criterion functional to be minimized, and the permissible mechanical stresses are the

constraints. The vanes are represented as naturally curving beams with a variable cross section. The rim of the baffle is mounted elastically around its periphery and both are subject to bending as well as twisting. The design problem is formulated as a fourteenth-order stiffness matrix for as many finite elements as the structure has been subdivided into, all vanes being identical and each subdivided into at least 15-20 elements to ensure the necessary accuracy. The resolvent equations are obtained through application of the principles of diakoptics and are solved by standard methods. The problem of shape optimization is solved by the projection method, after preliminary approximation with function series. The algorithm has been programmed in FORTRAN for a BESM-6 high-speed computer. Typical vane profiles are shown. Also the longitudinal distribution of maximum and minimum axial drag torques in an I = 0.485 m long optimum vane. Selecting the number of guide vanes and optimizing this number is the next, relatively easy, step. Figures 3, references 11 Russian.
[140-2415]

VIBRATION RESISTANCE OF OR-12PM KTZ DRIVE TURBINES

Moscow ENERGETIK in Russian No 3, Mar 81 pp 24-25

LUPOLO, O. A., engineer

[Abstract] When the PTN 1150-340 LMZ pump in plant number 6 at the Kostromskaya GRES drive plant OR-12PM KTZ was opened up, the connective gear clutch revealed 1-2 mm of wear. Because of a lack of time, the sprocket on the clutch was left unchanged. Low-frequency vibrations later developed in the first bearing, reaching 3--35 Hz. The turbine rotor of the OR-12PM is rigid, and the basic reason for dynamic stability loss of the turbine plant is the unsatisfactory operation of the connective gear clutch. These intrinsic vibrations destroy the babbit casting of the front bearing. Due to losses of dynamic stability and the resulting unsatisfactory operation of the connective clutch (tangential beveling of the teeth, etc.) this destruction is inevitable. Figures 2.
[81-8617]

UDC 621.436

UTILIZING THE ENERGY OF A PULSATING FLOW IN A GAS TURBINE

Moscow ENERGOMASHINOSTROYENIYE in Russian No 4, Apr 81 pp 7-10

MERZLYAKOV, V. A., candidate of technical sciences

[Abstract] A method is proposed for calculating a turbine that operates in a flow with regularly varying (pulsating) parameters at low frequency. The technique is based on the principle of maximum utilization of the greatest energy of the pulsating flow. An analysis is made of the physical processes that accompany transfer of the pulsating flow to a turbine. The proposed method describes the actual processes of turbine operation in a pulsating flow to a better approximation with Euler theory than conventional methods under the same conditions. An examination is made of possibilities for utilizing the energy of rotating masses in the gas turbine powerplant. The values of u/C_0 are optimized for a turbine with regularly varying parameters of the working fluid. Figures 2, references 10 Russian.

[119-6610]

NAVIGATION AND GUIDANCE SYSTEMS

UDC 531.383+522.4

TYPICAL PROGRAM FOR CALCULATING THE ERROR OF A PLOTTER OF STELLAR COORDINATE SYSTEMS DUE TO NOISE AT THE POWER AMPLIFIER OUTPUT

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian
No 4, Apr 81 pp 57-61 manuscript received 11 Apr 79

SERGEYEV, M. A., YUSHCHENKO, V. I., LEVANENKO, V. A., and RYSAKOVA, T. N.,
Chair of On-Board Control Instruments, Leningrad Institute of Precision Mechanics
and Optics

[Abstract] Plotters of stellar coordinate systems are used in astronavigation for determining the angular coordinates of a spacecraft. Errors in calculation of the course are determined by the errors in measurement of the course angles of stars, while errors in calculation of roll and pitch are determined mainly by the errors in measurement of their altitudes. It has been found that the measurement errors are largely due to noise at the power amplifier output. Accordingly, algorithms have been constructed for calculating the rms errors of the direction finder due to this noise. Typically, control of the principal axis of the direction finder relative to a "fixed" star on the basis of the course angle can thus be realized. The algorithm follows the equation of control, with negligibly short time constants of the photocurrent amplifier and the power amplifier. For simplicity, only one perturbation due to amplifier noise is considered. The algorithm has been programmed in accordance with the structure of the control system, written in FORTRAN for a computer, A noise-error graph facilitates determination of the maximum rms error of the course angle for any star altitude not exceeding 60°. Also the rms errors of the course angle and the star altitude can thus be quickly determined when the amplifier noise characteristics are known. On the other hand, the upper limit on permissible amplifier noise can be established below which the latter will not affect the rms errors of measurements made by a star direction finder. Figures 3, references 5 Russian.
[133-2415]

UDC 531.383

DRIFTS OF A GYROSCOPE WITH FRICTION ON THE SHAFTS DUE TO RANDOM VIBRATIONS OF THE PLATFORM

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian No 4, Apr 81 pp 51-56 manuscript received 19 May 80

ZHIGALKO, T. V. and LESTEV, A. M., Chair of Theoretical Mechanics, Leningrad Institute of Aviation Instrument Design

[Abstract] A gyroscope in Cardan gimbals is considered and its accuracy during random vibrations of the platform is estimated, taking into account both dry and viscous friction on the shafts and bearings. The equations of motion are solved by the method of successive approximation following statistical linearization, assuming the random processes to be stationary and stationarily coupled. The angular drift velocities and the errors of wheel position readings are calculated on this basis. A typical numerical example demonstrates how the friction torques decrease the accuracy of such a gyroscope during vibration of its platform. Figure 1, references 7 Russian.
[133-2415]

UDC 534.2;534.42

ACOUSTIC IMAGING BASED ON PARAXIAL ANISOTROPIC DIFFRACTION OF LIGHT BY ELASTIC WAVES IN CRYSTALS

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 27, No 3, May-Jun 81 pp 377-383
manuscript received 25 Jun 80

ZYURYUKIN, Yu. A., Saratov State University imeni N. G. Chernyshevskiy,
Scientific Research Institute of Mechanics and Physics

[Abstract] A physical analysis is made of acoustic imaging based on collinear anisotropic acoustic interaction between light and deformation waves. Since nearly collinear acoustooptic interactions are also realized in imaging, the term "paraxial" is used instead of collinear in describing the imaging process. As a rule, this type of interaction is realized only in crystals. One of two possible light waves in the crystal, moving collinearly or nearly collinearly with a deformation wave, is diffracted by this wave, giving rise to light of a different polarization with somewhat displaced optical frequency. The typical feature of anisotropy is the fact that light waves of two different polarizations may propagate in the crystal at two different velocities. Besides, they become associated only in the presence of a certain strain of the crystal in the form of a wave. This is formally expressed by the corresponding component of the tensor of photoelasticity. From the formal standpoint the conditions of collinear anisotropic interaction are expressed by satisfaction of laws of conservation of momentum and energy. An examination is made of the particulars of reading out the acoustic wave fields by a planar optical wave in crystals that permit imaging by this technique. It is shown that the transverse scales of the resultant optical image are retained (in comparison with the acoustic original), while the longitudinal dimensions are distorted. This distortion can be eliminated by forming the real acoustic image inside the region of interaction. Figures 6, references 6: 2 Russian, 4 Western.
[136-6610]

UDC 621.039.647

SODIUM TARGET OF A NEGATIVE ION INJECTOR

Moscow ATOMNAYA ENERGIYA in Russian Vol 49, No 4, Oct 80 pp 246-251
manuscript received 6 Mar 80

D'YACHKOV, B. A., KRYLOV, A. I., KUZNETSOV, V. V. and SEMASHKO, N. N.

[Abstract] An investigation is made of the properties of the sodium charge-exchange target as one of the principal elements of the MIN negative ion injector. This is a continuous-duty supersonic sodium vapor target with apertures of 22x48 cm. The injector is designed to produce a negative hydrogen ion current of 5-10 A. Measurement results are given on the thickness of the target, its profile, vacuum properties, and entrainment of sodium into the apertures. The target has a work life of 65 hours, and can produce quasisteady hydrogen and deuterium ion beams. The use of such a target in the form of a continuous supersonic vapor jet of considerable width should improve injector design. Figures 4, references 15: 10 Russian, 5 Western.
[129-6610]

UDC 535.214.4.089.6

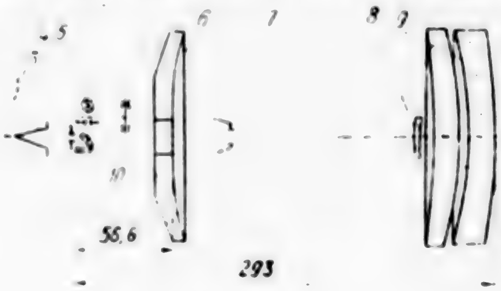
COLLIMATED GRADUATION SOURCE OF INFRARED RADIATION

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 3, Mar 81 pp 22-25
manuscript received 6 Jun 79

PAVLYUKOV, A. K., KHOLOPOV, G. K., PARAMONOV, P. I., FILIPKOV, V. D. and KHALIULLIN, F. M.

[Abstract] Collimated radiation sources are convenient for energy graduation of optoelectronic devices that respond to radiation emitted by remote objects. Such sources consisting of a collimation lens and a miniature emitter in the focal plane of the lens are set up directly in front of the entrance pupil of the device to be graduated and simulate an infinitely remote point source of radiation. This paper describes such a source for graduating radiometers under in situ and bench conditions at ambient temperatures from 263 to 323 K. The radiators are an ideal black body 1 with working temperatures of 373 and 573 K, and TRSh 1500-2300 lamp 5 at filament temperatures above 1000 K. Diaphragms 2 and 3 are situated in the focal plane of the objective lens, which is made up of spherical mirrors 6 and 8, and corrective refracting elements 9. The aberration-free spectral range of the objective lens system is 1.2-6 μm. The position of mirror 10 determines which source is being used. Curtain shutter 4 is kinematically coupled to mirror 10,

and cuts off the radiation from lamp 5. Hood 7 cuts out stray radiation from the sources that has not passed through the mirrors of the objective system. The device is made in such a way that during operation its inside blackened surface is a nearly isothermal cavity with a single opening that coincides with the exit pupil of the objective system. Therefore the resultant radiation is very close to the emission of an ideal black body at the ambient temperature. The source includes instrumentation for measuring nonuniformity of radiation, measuring and monitoring the transmission factor of the objective system, measuring the coefficients of radiation of the coating on the walls of the cavity, and comparing the contrast irradiances produced by the black body and the lamp. The instrument measures 440x200x150 mm and masses 8.5 kg.



Figures 5, references 5 Russian.
[123-6610]

UDC 621.284.66(373)

MICROSECOND RELATIVISTIC ELECTRON BEAM GENERATOR

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 2, Mar-Apr 81 pp 22-24
manuscript received 21 May 79

BELOMYTTSEV, S. Ya., KIM, A. A., KOLGANOV, N. G., KOTOV, Yu. A., KOSHELEV, V. I., SUKHUSHIN, K. N. and TIMOFEYEV, M. N., Scientific Research Institute of High Voltages at Tomsk Polytechnical Institute

[Abstract] The article describes the REM beam generator, which is a relativistic electron linac with intermediate inductive energy storage and an exploding-wire current interrupter. The electron beam is shaped in a cylindrical diode with magnetic insulation. The diagram shows the construction of the device. The primary energy source is a five-stage Marx generator with output voltage of 200-450 kV and impact capacitance of 0.31 μF. This pulse generator has a self-inductance of 2 μH. The generator produces relativistic electron pulses with duration of 1-3.5 μs, current amplitude of 1.5-17 kA and electron energy of 200-650 keV.

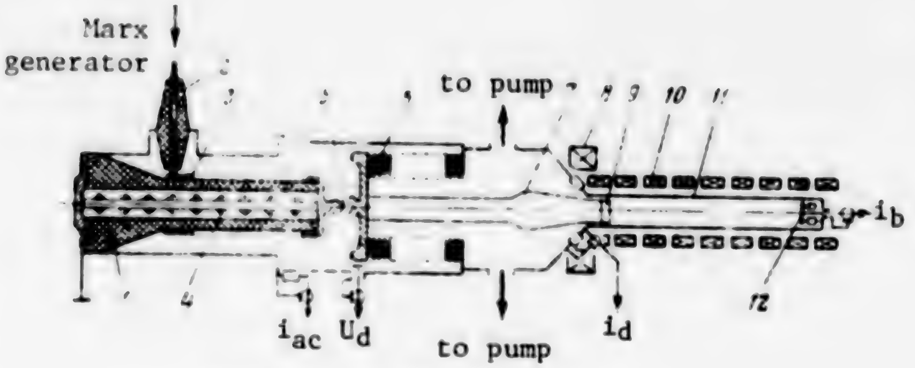


Diagram of REM accelerator:
1--insulator, 2--feed-through insulator, 3--inductance, 4--exploding-wire interrupter, 5--peaking discharger, 6--vacuum insulator, 7--cathode holder, 8--correction coil, 9--cathode, 10--solenoid, 11--drift tube, 12--collector, i_{ac}--accumulator current, U_d--diode voltage, i_d--diode current, i_b--beam current.

Figures 2, references 6 Russian.
[130-6610]

UDC 621.384.64

MULTIBEAM HEAVY ION ACCELERATOR WITH PHASE-VARIABLE FOCUSING

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 2, Mar-Apr 81 pp 25-27
manuscript received 14 Sep 78, after revision 26 Nov 79

KUSHIN, V. V., MURIN, B. P. and FEDOTOV, P. A.

[Abstract] Heavy-ion linacs use autophasing combined with focusing by magnetic quadrupole lenses. In these accelerators, the ions coming from the injector have a low initial velocity. This necessitates a careful approach to selection of the focusing system since the efficiency of magnetic focusing drops off as the initial velocity of the particles decreases. Therefore it is preferable to use electric focusing in the initial part of the accelerator. This paper examines the feasibility of using spatially homogeneous rf focusing and asymmetric phase-variable focusing to accelerate singly charged argon ions with charge-to-mass ratio of 1/40 at an initial velocity of 0.5% of the speed of light. To get a high-intensity beam, seven beams are simultaneously accelerated on the initial stages at an accelerating field frequency of 25 MHz. It is shown that when the ion energy reaches 0.4 MeV/nucleon, all the beams can be combined, and the resultant single beam can be further accelerated in a single channel at the same accelerating field frequency. The current of the singly charged argon ion beam may reach 105 mA at a

normalized beam emittance of 6 cm·mrad at the output. A further increase in beam intensity could be realized by using multibeam homogeneous rf focusing. Figures 3, references 7: 4 Russian, 3 Western.
[130-6610]

UDC 621.373

HIGH SPEED MATCHED IMPACT MAGNET

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 2, Mar-Apr 81 pp 30-33
manuscript received 5 Mar 80

VIZIR', V. A., LASHCHUK, N. A., MESHCHEROV, R. A., RYBALKO, V. S. and SHCHERBININ, V. P., Scientific Research Institute of Nuclear Physics at Tomsk Polytechnical Institute

[Abstract] The paper describes an experimental model of a section of an impact magnet for extracting a proton beam from the buncher-accumulator of a 600 MeV meson factory. It is assumed that the protons accumulated in the buncher will be circulated as four bunches with duration of 30 ns each with a 25 ns interval. On the first stage the total beam will be coupled out in a single revolution with linac operating frequency of 100 Hz. On the second stage, the individual bunches will be extracted in turn with a frequency of 400 Hz. Preliminary research on such a beam extractor has shown that the requirements of the problem are most fully met by a deflecting device of the impact magnet type in the form of an artificial line that is impedance-matched to the transmission line and the generator. The magnet proposed by the authors has the following parameters: interval of deflecting magnetic field lengthwise of the magnet $6 \cdot 10^{-3}$ T·m, settling time of the deflecting field 21 ns, aperture 12 x 6 cm, length 15.6 cm, number of cells 7 impedance 20 Ω, pulse delay 18 ns, pulsed supply voltage 40 kV. Figures 3, references 7: 5 Russian, 2 Western.
[130-6610]

UDC 539.1.075:523.165

TIME-OF-FLIGHT SCINTILLATION TELESCOPE WITH LOGICAL SAMPLING

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 2, Mar-Apr 81 pp 58-61
manuscript received 23 Nov 79

AKIMOV, D. Yu. and KOTOV, Yu. D.

[Abstract] A new time-of-flight system is proposed for a gamma telescope that uses a logic circuit to distinguish events of forward and reverse flight of particles

from two scintillation counters with dimensions of the same order of magnitude as the flight base. Discrimination of events without measuring the time of flight enables elimination of the intermediate step of translating logic information to analog form, making the system more reliable and flexible, and reducing the time of generation of the output trigger signal. Photomultipliers looking at both faces of the counters form two independent channels on each counter. The times of activation of the channels of the lower counter are compared with the times of operation of the corresponding channels of the upper counter. The logic circuitry selects events with a given multiplicity of meeting the condition of advanced activation of the upper counter channels. Analysis of experimental results shows that the proposed time-of-flight system is equal to conventional gamma telescopes in its principal characteristics, but is more reliable and simpler. Figures 4, references 6: 1 Russian, 5 Western
[130-6610]

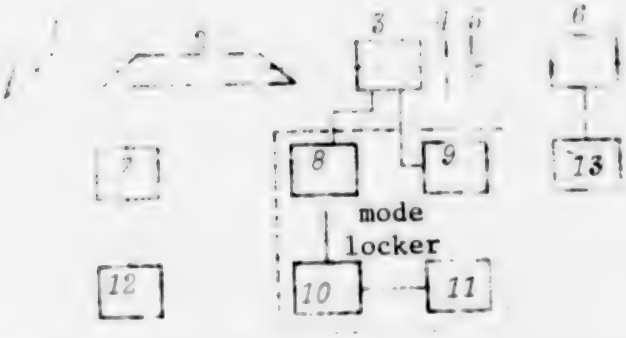
UDC 621.373.018.756:621.373.029.67

SUBNANOSECOND OPTICAL PULSE GENERATOR BASED ON AN ARGON ION LASER

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 2, Mar-Apr 81 pp 185-187
manuscript received 22 Oct 79

BAKINOVSKIY, K. N., BARANOV, G. N. and SHARONOV, G. V., Scientific Research Institute of Applied Physics Problems of Belorussian State University, Minsk

[Abstract] A subnanosecond optical pulse generator with tunable emission wavelength is described. A block diagram of the device is shown in the figure. The generator is based on the LG-106M1 Ar^+ laser with active mode locking. A Litthrow prism 1 was substituted for the opaque mirror of the laser cavity to provide tuning. Iris diaphragm 4 is for transverse mode selection inside the optical cavity. Output mirror 5 is mounted on a micrometer screw for continuous adjustment of the length of the cavity. The active element 2 is connected to power supply 12 through filter 7 with L = 60 mH, C = 5 mF [sic]. Pulsations of output intensity do not exceed 3%. The pulse recurrence rate of the laser is 140 MHz, and pulse duration is less than 0.3 ns. No changes in pulse duration were observed after 5 hours of continuous operation.



Block diagram of optical pulse generator

1--Litthrow prism; 2--active element; 3--acousto-optical modulator; 4--iris diaphragm; 5--mirror; 6--avalanche photodiode; 7--LC smoothing filter; 8--reflectometer; 9--thermostabilization system; 10--resonant power amplifier; 11--LC oscillator; 12--power supply; 13--stroboscopic oscilloscope

Figures 3, references 3: 1 Russian, 2 Western.
[130-6610]

UDC 621.372.852.3:532.783.087

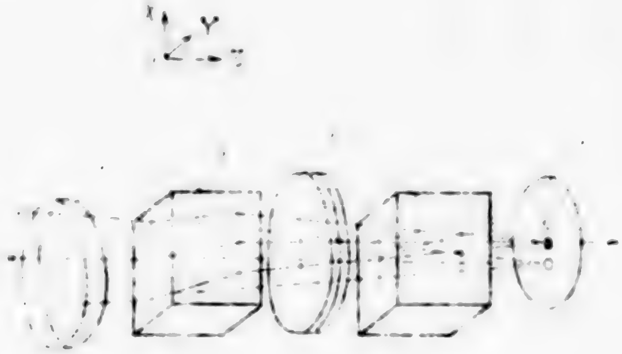
LIQUID-CRYSTAL DEVICE FOR CONTROLLING OPTICAL RADIATION

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 2, Mar-Apr 81 pp 190-192
manuscript received 10 May 79

AZAROV, A. D., KOVAL', S. S., MALKOV, A. V., MITROFANOV, V. V. and TRAPEZNIKOV, M. B.

[Abstract] A liquid-crystal attenuator is proposed for maintaining a constant optical signal at the input of optoelectronic devices. The diagram shows the optical system of the device. The liquid crystal is held between two birefringent plates. The dimensions of the birefringent elements are reduced by using matching lens 1. The plates are crystals of calcite $(CaCO)_3$. Both crystals 2 are cut so that their optical axes lie in the YZ plane at the same angle to the OZ axis, and the length of the crystals is the same in the direction of propagation. When radiation is incident on the first plate 2, the output is two orthogonally polarized beams. Liquid-crystal cell 3 turns their plane of polarization through 90°. At the output of the system, the middle image of the source registers with field diaphragm 4. When controlling voltage is applied to the liquid-crystal cell, the angle of rotation of the plane of polarization of the radiation passing through the cell becomes less than 90°, and the power of the radiation is redistributed to the

lateral images of the source, decreasing the signal at the output. At some value of the controlling voltage, the polarization of the transmitted radiation remains unchanged, and all luminous power goes to the lateral images of the source, so that no light passes through the diaphragm. Because of imperfections in the optical elements and liquid-crystal cell, the actual coefficient of contrast in a real attenuator of this design is >300. In the open state, the transmission of the attenuator is 65%, which could be increased to 90-92% by using antireflection coatings on the optical elements.



Figures 2, references 7 Russian.
[130-6610]

UDC 662.997

PERFORMANCE CHARACTERISTICS OF A SOLAR THERMOELECTRIC GENERATOR AND COMPARISON OF EXPERIMENTAL AND THEORETICAL DATA

Tashkent GELIOTEKHNIKA in Russian No 6, 1980 pp 69-70 manuscript received 25 Aug 78

MOVSUMOV, E. A. and BAYRAMOV, A. M., Kirovabad State University imeni G. Zardabi

[Abstract] A performance evaluation is done on a solar thermoelectric generator designed for cathodic corrosion protection of off-shore oil field structures. The concentrator of the facility was a PZS-45 projector with optical system made up of a glassed-in parabolic reflector 45 cm in diameter with focal length of 90 mm. Maximum temperature in a focal spot of 30 mm diameter is 300°C. Conventional low-temperature alloys were used for the branches of the thermocouples: Bi-Te-Se for the negative branch, and Bi-Te-Sb for the positive branch. Measurements were made of the open-circuit emf of the thermopiles, the voltage drop across the thermopile under an external load and the current flowing through it. The results were used to plot current-voltage curves of the thermoelectric generator with different temperature differentials. The resultant characteristics formed a family of parallel straight lines. These were then used to calculate the maximum power of the

thermopiles. It was found that maximum power and efficiency of the thermoelectric generator increase nearly linearly with an increase in temperature differential. Maximum productivity is from the hours of 11:00 to 2:00. References 7 Russian. [128-6610]

UDC 621.394-71:537.312.62:621.318

PULSED DIPOLE MAGNET MADE OF SUPERCONDUCTIVE TUBING WITH A CIRCULATING CRYOSTAT SYSTEM

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 2, Mar-Apr 81 pp 196-199 manuscript received 25 Sep 79

AGAPOV, N. N., D'YACHKOV, Ye. I., ZEL'DOVICH, A. G., KRYLOV, V. V., KUZICHEV, V. N., KULIKOV, Yu. V., KURYATNIKOV, Ye. K., MAKAROV, L. G., NIKITAYEV, P. I., SAZONOV, N. M., SMIRNOV, A. A., STEKOL'SHCHIKOV, V. V. and KHODZHIBAGIYAN, G. G., Joint Institute of Nuclear Research, Dubna

[Abstract] The article describes a superconductive pulsed dipole magnet developed as part of the nuclotron program at JINR, where a synchrotron is being built for relativistic acceleration of nuclei. The main structural element of the dipole is an iron yoke that takes the dynamic forces resulting from pulse excitation of the magnet winding. This yoke is 328 mm long and is built up of two symmetric parts made of transformer sheet steel 0.5 mm thick. The magnet has an aperture of 55 x 55 mm, and develops fields of up to 2.4 T. The winding has 16 turns and is made of superconductive tubing. The tubing is produced by winding $Nb_{50}Ti_{50}$ (NT-50) wire on German silver tubing. The tubing was then dipped in solder containing 95% tin and 5% silver. The length of the superconductive cable in the winding was 16 m and inductance of the magnet was 0.16 mH. Cooling was by two-phase helium in a circulating cryostat system. The relative mass content of vapor in the coolant was 0.43-1, and specific mass flowrate was 50-200 kg/m^{2}s. Degradation of critical current did not exceed 10% even when the rate of change in the field was as high as 3.5 T/s. A critical current of 7380 A was reached in testing. No changes in magnet characteristics were observed after dozens of transitions from the superconductive to normal state and after eight cooling cycles from room temperature to the liquid helium point. Figures 4, references 12: 5 Russian, 7 Western. [130-6610]

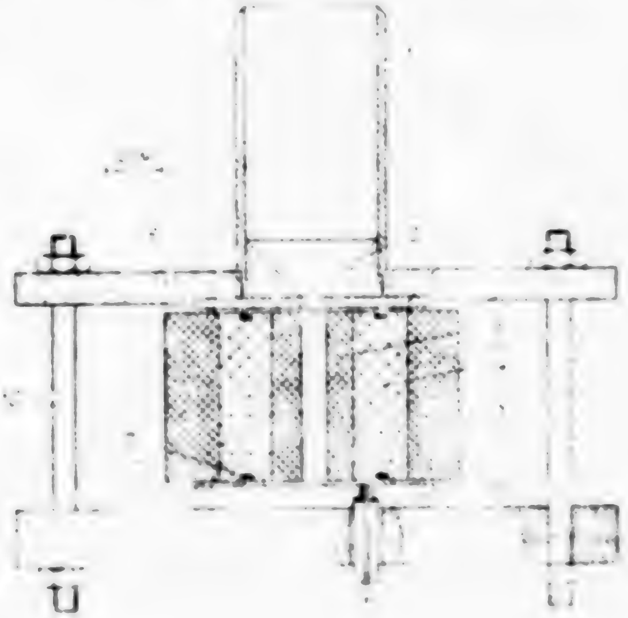
UDC 533.9.07

GENERATOR OF TOROIDAL VORTEX PLASMA FORMATIONS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 2, Mar-Apr 81 pp 237-238
manuscript received 20 Aug 79

LUCHANINOV, A. A., ROZHKOV, A. M., SEREDA, N. D. and SOKOLOV, N. P.,
Khar'kov State University

[Abstract] The authors describe a device for producing long-lived plasma toroids in air. The design of the device is shown in the diagram. The unit consists of a vacuum erosion discharge chamber, a cylindrical nozzle 1, and an adapter 2 for smooth transition from the small opening to the nozzle 1. The erosion discharge chamber is made up of dielectric cylinders 3, 4 and 5 that fit tightly into one another, and steel electrodes 6. The inner cylinder 3 is the inside wall of the chamber. The material of this wall and that of the electrodes determine the composition of the plasma. Intermediate cylinder 4 is made of Teflon. Rubber gaskets 7 in this cylinder seal the discharge chamber. Textolite outer cylinder 5 gives strength to the structure. The erosion discharge chamber is clamped between flanges 8 and 9 by four bolts 10. Cylinder 4 also acts as a dampter to take the shock during discharge. Duration of operation is determined by erosion wear of the inner cylinder 3 (which is replaceable) and electrodes 6. Energy is provided by a 140 μF capacitor bank charged to 10-15 kV. The device can produce plasma rings with diameter up to 25 cm, velocity of 20-30 m/s and luminescence time of 50 ms.



Figures 2, references 2 Russian.
[130-6610]

UDC 621.378.3

CONTINUOUS-WAVE SELENIUM-HELIUM GAS LASER

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 2, Mar-Apr 81 p 259
manuscript received 6 Dec 79

YEPREMYAN, V. B., IVANOV, I. G., PROZOROV, S. V. and SEM, M. F.,
Scientific Research Institute of Physics, Rostov State University

[Abstract] The article describes a selenium-helium gas laser for continuous emission in the blue-green region of the spectrum. The active mixture is excited by a positive d-c discharge column. The active zone of the discharge tube is 40 cm long and 0.2 cm in diameter. Injection of selenium vapor is by cataphoresis. In addition to the emitter, the device includes a stabilized power supply. The emission spectrum has a range of 0.49-0.53 μm. Radiation output power is 5 mW. Radiation mode is TEM_{00} with linear polarization, beam diameter of 1.5 mm and divergence of 3.5' or less. Measurements are 700 x 120 x 120 mm, and mass is 7 kg. Figure 1.
[130-6610]

UDC 629.12.073.243.3

EVALUATION OF THE DEPENDENCE OF A SHIP'S STABILITY ON ROUGH SEA ON THE COURSE ANGLE

Leningrad SUDOSTROYENIYE in Russian No 4, Apr 81 pp 13-15

NECHAYEV, Yu. I. and MEDVED', A. F.

[Abstract] The dependence of a ship's stability on the course angle is evaluated here by an approximate method involving mathematical and physical simulation. The dynamic stability of a ship at any course angle on a harmonically wavy sea has already been analyzed through numerical integration of differential equations describing the lateral drift and the heel of a ship in a gust of wind. From the resultant dependence of the tilting moment on the roughness parameters, the course angle, and the Froude number an expression has been found for the tilting moment as a third-degree function of the course angle, with coefficients including the ratio of minimum initial metacenter height to ship width. A regression equation for the equilibrium parameter as a function of twelve influencing factors is constructed with the use of data from planned experiments. This model is found to be sufficiently rigorous, according to estimates based on Fisher's and Student's tests at a 0.95 confidence level. It can be extended to the ship stability on an irregularly rough sea, most expediently with the aid of a storm diagram. On both regularly and irregularly wavy sea, according to the results of this analysis, the dynamic stability of a ship decreases sharply as the course angle falls within the 0 to ±30° range. Figures 4, references 4: 3 Russian, 1 Western.
[141-2415]

UDC 621.822.5.001.5

DEPENDENCE OF THE CHARACTERISTICS OF HYDRODYNAMIC BEARINGS IN TURBOMACHINES ON THE LOCATION AND THE WIDTH OF THE LUBRICANT FILM

Moscow ENERGOMASHINOSTROYENIYE in Russian No 5, May 81 pp 16-19

AGAFONOV, V. A., candidate of technical sciences

[Abstract] The design of hydrodynamic bearings for turbomachines is considered in terms of location and width of the lubricant film. The analysis is based on the model of a cylindrical journal bearing with classical characteristics such as the theoretically maximum possible width of the supporting lubricant film. The problem of establishing the boundaries of this film is reduced to a determinate one, with no thinning or discontinuity assumed to occur within the sliding zone. The load capacity, the lubricant flow rate, the friction loss, and the frequency of self-excited runner vibrations at the stability limit have been calculated as functions of the journal eccentricity for three bearings: complete cylindrical bearing of classical shape, a conventional bearing with a symmetrically located active surface γ = 100-180° wide, and a novel bearing with a sliding surface asymmetric relative to the central vertical axis, the trailing edge of that active surface located in the lower half and making an angle α = 15-40° with the plane of horizontal split. The performance characteristics of symmetric and asymmetric bearings are regarded as comparable when $180° - \gamma = 2\alpha$. The advantages of an asymmetric bearing are higher damping capacity of the lubricant film, wider runner stability region, lower frequency of self-excited runner vibrations, easier passage of the lubricant through the bearing clearance and almost complete elimination of thinning with resultant improved cooling, lower ratio of power loss to load capacity, and better utilization of the convergent gap segment. Figures 4, references 7 Russian.
[137-2415]

UDC 621.438

HEAT TRANSFER TO THE OIL AND COOLING OF THE LATTER IN A GAS TURBINE ENGINE

Moscow ENERGOMASHINOSTROYENIYE in Russian No 5, May 81 pp 9-12

[illegible], I. A., candidate of technical sciences, RYSHKOV, V. I., engineer, and SHATALOV, I. K., candidate of technical sciences

[Abstract] The problem of air cooling the lubricant in a gas turbine engine is considered, the thermal flux from the engine to the oil consisting of heat due to friction in the bearings, heat equivalent to the power lost in the oil pumping system, and heat transmitted to the oil from the hot engine parts. Each of these three components is calculated, assuming an isolated thermodynamic system without

heat transfer to the ambient medium. Then air cooling is calculated on the basis of an inverse 3/2 power relation between the temperature rise in the cooling air and the compressor speed. The results reveal that the temperature rise in the cooling air does not depend on the mode of engine operation. Installation of an oil cooler at the entrance to the compressor increases the pressure losses with a resulting loss in engine power and fuel economy. Estimates based on simple thermodynamic relations and calculations by the method of small deviations indicate that the relative increment of engine power and the relative decrement of fuel rate, upon restoration of the full pressure, are both proportional to the pressure recovery factor. Typical data are given for 440 kW aircraft engines such as the Lycoming LST-101. Figure 1; references 3: 2 Russian, 1 Western.
[137-2415]

UDC 532.517

INVESTIGATION OF THE STABILITY OF GAS-TYPE SUSPENSIONS

Moscow MASHINOVEDENIYE in Russian No 2, Mar-Apr 81 pp 93-99
manuscript received 15 Oct 79

GRUDSKAYA, Ye. G., Leningrad Polytechnical Institute

[Abstract] A cylindrical gas suspension whose hoisting capacity is produced by feeding compressed gas into a lubricant layer is considered. The number of pressurization apertures is assumed to be greater (N = 12-18) so that the aperture rows can be approximated by a linear source. Supports with an annular diaphragm are much more stable to the pneumatic hammer than suspensions with a simple diaphragm. The following qualitative notions confirm this. The appearance of pneumatic instability is usually related to the presence of some volume whose pressure fluctuations lag behind those in the lubricant layer. For supports with a simple diaphragm, the role of this volume is played by the volume of recesses of pressurization apertures. For supports of the proposed geometry, this volume does not have to be specified since they do not have any pneumatic instability over a wide range of change of the parameters. Figures 3, references 8: 7 Russian, 1 Western.
[86-5617]

UDC 533.6.011.5

THEORY OF THREE-DIMENSIONAL HYPERSONIC FLOW AROUND A SOLID

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 258, No 1, 1981 pp 42-44
manuscript received 22 Dec 80

GOLUBINSKIY, A. I. and GOLUBKIN, V. N.

[Abstract] A theoretical analysis is made of hypersonic flow around a three-dimensional body at an angle of attack, where the region of perturbed flow is a thin layer of strongly compressed gas. The characteristic ratio of densities on the compression head shock is taken as the small parameter. A general dynamic solution is found for a system of equations for the components of the velocity vector, the coefficient of pressure, density, and distribution of thickness of the compressed layer in a curvilinear orthogonal coordinate system fixed to the surface of the body with boundary conditions assigned on the compression shock. References 4 Russian.
[134-6610]

UDC 532.517

INFLUENCE OF PERTURBATIONS ON FLOW STRUCTURE IN THE REGION OF SEPARATION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 258, No 1, 1981 pp 45-48
manuscript received 29 Sep 80

DOVGAL', A. V., KOZLOV, V. V., KOSORYGIN, V. S. and RAMAZANOV, M. P., Institute of Inorganic and Applied Mechanics, Siberian Department, USSR Academy of Sciences, Novosibirsk

[Abstract] Mathematical models of aerodynamics problems with separation of the boundary layer from a smooth surface usually disregard perturbations of the flow, even in regions of unfavorable pressure gradients. However, experimental research has shown that vortex oscillations are formed in the boundary layer of a wing under natural conditions even when the level of external perturbations is low. Since the flow structure in the boundary layer is largely determined by the behavior of these perturbations, the authors of this paper study the development of artificially introduced controlled perturbations in the boundary layer of a straight wing in the region of unfavorable pressure gradients (positive in the direction of flow), and analyze the influence of these perturbations on the structure of the average flow. Experiments were done in a subsonic wind tunnel. Artificial perturbations were introduced by a vibrating ribbon technique. A constant-temperature hot-wire anemometer with linearized characteristic was used to study the flow field in the

boundary layer. All measurements were made at an incident flowrate of 5.7 m/s and Reynolds number of $2.66 \cdot 10^5$. Mean-velocity profiles are compared with and without perturbations. It is shown that the flow structure in the boundary layer with unfavorable pressure gradient and laminar separation from a smooth surface is very sensitive to flow perturbations. Vortex perturbations of initially low amplitude are intensified on the section of positive pressure gradient, and lead to considerable restructuring of the laminar flow, and elimination of boundary layer separation. It is concluded that problems of flow stability in the region of separation must be accounted for in mathematical models of problems in aerodynamics.
Figures 4, references 4: 3 Russian, 1 Western.
[134-6610]

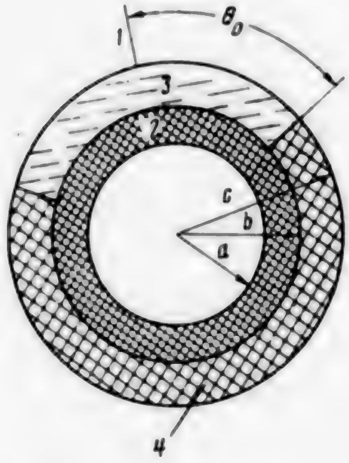
UDC 534.86

ACOUSTIC CHARACTERISTICS OF A SHIELDED CYLINDRICAL PIEZOELECTRIC TRANSDUCER RADIATING THROUGH A LIQUID LAYER

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 27, No 3, May-Jun 81 pp 358-362
manuscript received 25 Oct 79 after revision 5 May 80

DIANOV, D. B., ZADIRIYENKO, I. M. and KUZ'MENKO, A. G., Leningrad Electrical Engineering Institute imeni V. I. Ul'yanov (Lenin)

[Abstract] An analysis is made of emission of sound by a piezoceramic shielded cylinder with arbitrary wall thickness through a liquid layer. The presence of an intermediate layer filling an unshielded space between the radiating surface of the cylinder and the ambient medium changes the acoustic load on the transducer. Therefore the authors study the influence that the geometric dimensions and parameters of elasticity of the layer have on the frequency response of the transducer. The problem is solved by the method of partial regions [I. V. Vovok, V. G. Grinchenko, V. I. Mayatskiy, "Acoustic Field of an Infinite Cylindrical Transducer Partly Covered by a Layer of Acoustically Soft Material," AKUSTICHESKIY ZHURNAL, Vol 18, No 3, 1972, pp 365-369]. The cross section perpendicular to the axis of the transducer is shown in the diagram. Expressions are derived that can be used to analyze the way that the frequency properties and directionality of the shielded transducer depend on the dimensions of the shield and the parameters of the intermediate layer. The shielding of the transducer increases mismatch with the ambient medium and narrows the passband. Analysis of a specific example for TBK-3 piezoceramic material with radius ratio $b/a = 1.2$ and shielding sector $\pi - \theta_0 = 120^\circ$ shows that despite the local nature of acoustic loading, which is distributed along only a part of the lateral surface of the shielded transducer, the dimensions of the shielding and parameters of the intermediate layer can be selected to expand the passband by a factor of 2.5-3.



1--external medium,
2--piezoelectric cylinder,
3--intermediate layer,
4--shield

Figures 2, references 3 Russian.
[136-6610]

UDC 533.6.011.72

OSCILLATIONS OF A SHOCK WAVE UPON REFLECTION FROM A RESONATOR

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 27, No 3, May-Jun 81 pp 373-376
manuscript received 6 May 80

ZNAMENSKAYA, I. A., IBRAGIM, M. A. and SHUGAYEV, F. V., Moscow State University imeni M. V. Lomonosov

[Abstract] When a shock wave is incident on an obstacle, the gas stream behind the wave front flows around the obstacle. If the transverse dimensions of the obstacle are finite, and the stream behind the incident wave is homogeneous and supersonic, steady-state flow is set up with a forward shock. Recent experimental research in this field has shown flow pulsation in working with supersonic resonance tubes. In this paper it is shown that when a shock wave is reflected from a resonator with cavity facing the flow, the head wave undergoes regular damped oscillations in the process of steady-state transition to flow around the model. A secondary shock is observed that plays a definite part in the onset of these oscillations. The experiments were done in a shock tube with resonators of two types held parallel to the oncoming flow: 1) a model of a three-dimensional resonator--a cylindrical resonance tube with one open end having sharp edges; 2) a model of a two-dimensional resonator--two parallel plates with sharp edges. The pusher gas was helium or nitrogen, and the working gas was air. Mach numbers of the incident wave ranged from 2.2 to 5.5. The analysis of the process was based on schlieren photographs and interference patterns of the interaction between the shock wave and the resonator. The light source was a Q-switched ruby laser. Flow perturbations behind the incident wave are formed on the sharp edges of the model as compression waves. As these waves overtake one another, they form a new shock wave that follows the

reflected wave at nearsonic velocity, overtaking the reflected wave within a certain time after leaving the resonator. Then a new shock wave is formed with intensity depending on the depth of the resonator. Rarefaction waves propagating from the edges of the model slow down the forward shock. After interaction with the rarefaction wave that arises upon merging of the shock waves and is then reflected from the bottom of the resonator, the forward shock passes the position corresponding to steady-state flow, and then again moves away from the model. The rarefaction wave is reflected from the shock wave in the form of a compression wave with profile increasing in steepness as it moves inside the resonator, and then it overtakes the head wave once more. The low coefficient of reflection causes rapid damping of the oscillations. Figures 4, references 6: 5 Russian, 1 Western. [136-6610]

UDC 551.463.26

SCATTERING OF SOUND BY THREE-DIMENSIONAL INHOMOGENEITIES OF UNDERWATER GROUND BOUNDED BY AN UNEVEN SURFACE

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 27, No 3, May-Jun 81 pp 384-390 manuscript received 7 Aug 80

IVAKIN, A. N. and LYSANOV, Yu. P., Acoustics Institute imeni N. N. Andreyev, USSR Academy of Sciences

[Abstract] Previous research has dealt with scattering of sound by random fluctuations in the index of refraction of underwater bottom ground with the common assumption that the average density and speed of sound in the bottom are the same as in the nearby water. In this case, scattering is only by three-dimensional inhomogeneities. However, under real conditions in the ocean, the bottom is uneven, and the average acoustic parameters of the bottom ground and of the water are frequently different. In this paper, the authors consider the case where scattering takes place both on three-dimensional inhomogeneities in the ground, and on uneven spots on the surface of the ground. The analysis is based on the first approximation of the method of small perturbations. Experimental and theoretical data are compared for the angular dependence of the coefficient of scattering of sound by the ocean bottom. Figures 5, references 9: 8 Russian, 1 Western. [136-6610]

UDC 534.24-26

REFLECTION OF A PLANE ACOUSTIC WAVE FROM A LIQUID INHOMOGENEOUS LAYER LYING ON AN ELASTIC HALF-SPACE WITH LAMINAR INHOMOGENEITY

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 27, No 3, May-Jun 81 pp 428-483
manuscript received 31 Mar 80

MASLOV, V. P., Institute of Oceanology imeni P. P. Shirshov

[Abstract] A method is proposed for finding the coefficient of reflection from a number of homogeneous liquid and elastic layers. Structurally simple matrices relate the displacements and stresses on the opposite surfaces of each layer. On the basis of the resultant expression for the coefficient of reflection, successive approximation formulas are derived for thin inhomogeneous layers with continuous variation of the parameters of the layers. For an elastic layer, the coefficient of reflection is represented as a ratio of matrix series. The coefficients of these series are iterated integrals over the thickness of the layer. References 4 Russian.
[136-6610]

UDC 532.526

INFLUENCE OF DEEP COOLING ON TRANSITION IN A SUPERSONIC BOUNDARY LAYER

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 2, Mar-Apr 81 pp 43-49 manuscript received 29 Aug 79

LYSENKO, V. I. and MASLOV, A. A., Novosibirsk

[Abstract] Experiments are done to determine the conditions under which transition reversal may occur between laminar and turbulent boundary layers when the surface is cooled. Transition reversal is behavior such that the transition Reynolds numbers first increase and then decrease with decreasing temperature factor T_w, and then rise abruptly at very low surface temperatures. The experiments were done in wind tunnels at Mach numbers of the incident flow $M_\infty = 4.0$ and 3.0, and unit Reynolds numbers $Re_1 = 35 \cdot 10^6$ m^{-1} and $45 \cdot 10^6$ m^{-1}. The model was a flat plate 450 mm long, 200 mm wide and 9 mm thick with 0.1 mm of the leading edge blunted by a 20° bevel. The plate was secured to the side wall of the tunnel at a zero angle of attack. The temperature factor T_w was varied from 0.3 to 1.0. The surface temperature was measured by thermocouples. The position of the laminar-to-turbulent transition was determined by measurements of the total pressure distribution, using Pitot tubes and a heat-loss anemometer. It was found that unless frost forms on the model, the transition Reynolds number falls monotonically with decreasing temperature factor. Transition reversal is observed only when there is frost on the model. It is

concluded that the reduction in the transition Reynolds number is due to the roughness introduced by the frost. The abrupt increase in Re* at very low temperatures is attributed to a change in structure of the frost. Figures 4, references 21: 15 Russian, 6 Western.
[127-6610]

UDC 532.526:536.24

INFLUENCE OF SWIRLING ON HEAT EXCHANGE IN HYPERSONIC FLOW AROUND BLUNT BODIES

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 2, Mar-Apr 81 pp 50-57 manuscript received 8 Aug 79

ZEMLYANSKIY, B. A., LUNEV, V. V. and MARININ, V. P., Moscow

[Abstract] A high-entropy gas layer with large transverse gradients of entropy, density and gas velocity is formed near the surface of blunt bodies in a hypersonic gas flow. This vortex interaction is usually accompanied by an increase in heat flux and friction stress on the wall as compared with the classical values calculated in the thin boundary layer approximation, where the parameters on the outer boundary of the layer are taken as equal to the inviscid parameters on the body. The effect has been studied previously on the lateral surface of slender blunt bodies in a hypersonic flow. In this paper it is shown that the effect may be more appreciable, and may even have a qualitative influence on flow around non-slender blunt bodies if the radius of curvature of the departing shock wave on the axis is small compared with the radius of the midsection of the body. Similarity is found between the distributions of thermal fluxes with consideration of swirling of the inviscid shock layer on weakly blunted cones with vertex angle less than the critical value where flow around the corresponding sharp cone takes place with a shock attached to the vertex. Figures 5, references 11: 9 Russian, 2 Western.
[127-6610]

UDC 532.593

PLANT PROBLEM FOR INTERNAL SHOCK WAVES GENERATED BY MOVING SINGULAR SOURCES

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 2, Mar-Apr 81 pp 77-83 manuscript received 9 Jul 79

GORODTSOV, V. A. and TEODOROVICH, E. V., Moscow

[Abstract] Waves are set up when bodies move in a fluid of inhomogeneous density that is located in a field of gravity even at low velocities and in the absence of

boundaries. In calculations of the fields of such internal waves produced by moving bodies, a widely used method is based on substituting systems of point sources for the bodies. Approximate or numerical solutions are generally found by this method. In this paper, exact results are found relating to the spectral distribution of wave emission and the total energy of radiation per unit of time for some very simple sources in the planar case for an incompressible fluid that is exponentially stratified with respect to density. The force of wave drag is found by simple division of the energy losses per unit of time by the speed of the source. Some results for the three-dimensional case are also briefly formulated for comparison.
References 12: 10 Russian, 2 Western.
[127-6610]

UDC 533.6.011.8

HYDRODYNAMIC SIMILARITY OF HYPERSONIC FLOWS OF RAREFIED GAS AROUND BLUNT BODIES

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 2, Mar-Apr 81 pp 130-135 manuscript received 22 Aug 79

LARIN, I. N. and RYKOV, V. A., Moscow

[Abstract] An examination is made of the problem of flow of a diatomic gas around blunt bodies, and dimensionless numbers are derived for hypersonic flows based on model kinetic equations. Limits of applicability for these criteria are established. Numerical calculations confirm the exact and approximate laws of hydrodynamics, and enable comparison with experimental results. An investigation is made of the influence that the laws of viscosity have on the way that the drag of a sphere depends on the Reynolds number Re_0 defined with respect to the viscosity at the stagnation point. It is shown that model kinetic equations with a Lennard-Jones viscosity law can be used to calculate the drag of blunt bodies in hypersonic flows of rarefied gas with acceptable accuracy. Figures 5, references 9: 8 Russian, 1 Western.
[127-6610]

UDC 532.135

INFLUENCE OF POLYMER ADDITIVES ON THE LARGE-SCALE STRUCTURE OF THE VELOCITY FIELD IN THE VICINITY OF THE WALL OF A SPHERE

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 40, No 4, Apr 81 pp 645-650
manuscript received 30 Jul 80

PURIS, B. I., POLESSKIY, E. P., GALUTS, V. V. and AYEROV, V. Ye., Institute of Heat and Mass Exchange imeni A. V. Lykov, BSSR Academy of Sciences, Minsk

[Abstract] Experiments are done to determine the influence that polymer additives of different molecular weights have on some characteristics of the velocity field when a fluid flows around a sphere. The paper gives the results of visual observations and measurements made by laser anemometer in the vicinity of the wall of a sphere in a flow of water, a polyhydroxyethylene solution and a solution of sodium salt of carboxymethylcellulose. The experiments are done in a closed hydrodynamic channel with volume of 3500 liters of flowrates of 1.4-3 m/s. The sphere was 35 mm in diameter. The flow pattern was recorded by high-speed motion picture photography, using an additive of about 1% milk as a colorant. The results show a relation between the transformation of regular structures and the presence of polymer additives that considerably reduce drag. Thus it should be possible to control drag by acting on large-scale flow structures. Figures 3, references 17: 9 Russian, 8 Western.
[126-6610]

UDC 553.601.1

JET FLOW AROUND A MOVING SURFACE

Novosibirsk IZVESTIYA SIBIRSKOGO OTDELENIYA AKADEMII NAUK SSSR: SERIYA TEKHNICHESKIKH NAUK in Russian No 3, Issue 1, 1981 pp 33-41
manuscript received 28 Jul 78

BEKTURGANOV, Ye., DZHAUGASHTIN, K. Ye., SAKIPOV, Z. B. and YARIN, A. L., Leningrad Higher Naval Academy imeni V. I. Lenin

[Abstract] The field of propagation of jets over stationary surfaces has been fairly well covered in the literature. In some technical applications in metallurgy, chemical technology and so on, an analysis of jet flows developing near a moving surface is important. This area has been somewhat neglected. In this paper the authors give theoretical and experimental data on submerged laminar and turbulent jets propagating over moving surfaces. Accompanying and opposed motion of jets of incompressible fluid and the surface are considered. Laminar flow is analyzed by

two methods: an approximate method of localized self-similarity, and an exact method based on numerical solution of the initial boundary-layer equations. Turbulent jets were studied experimentally on a specially developed facility. The moving surface was modeled by a continuous belt under constant tension. Above the belt was a slit nozzle through which air was discharged at 50 m/s. Special measures were taken to eliminate air gaps between the nozzle and the belt. Velocity profiles in cross sections of the jet were measured for different flow parameters. The experimental data on turbulent flow agree qualitatively with the theoretical results on laminar flow around a moving surface when the plate is moving in the direction of the initial pulse jet. In the case of opposed motion, the flow pattern is qualitatively different for the laminar and turbulent cases. Figures 6, references 12: 11 Russian, 1 Western.
[121-6610]

MECHANICS OF SOLIDS

UDC 621-755-251

CHARACTERISTIC FEATURES OF BALANCING A NONUNIFORMLY ROTATING UNBALANCED ROTOR

Moscow VESTNIK MASHINOSTROYENIYA in Russian No 4, Apr 81 pp 56-59

SAMSAYEV, Yu. A., candidate of technical sciences

[Abstract] The balancing of a nonuniformly rotating unbalanced rigid rotor on two bearings is considered, where fluctuation of the rotor speed distorts the information about the rotor unbalance which the machine needs for correcting it. A kinematic and dynamic analysis reveals that the unbalance forces in the correction plane remain constant with time, depending only on the distribution of masses and on geometrical factors. While a conventional balancing procedure can be used, special more stable and accurate instruments are required. The accuracy of measurements can be improved by means of devices such as vectometers, phase detectors, or electrical filters automatically tunable to the rotor speed, and discriminator-amplifiers with automatic frequency tuning (tracking filters). Figures 3, references 4 Russian.
[147-2415]

UDC 621.333:621.337.41

SELF-EXCITED VIBRATIONS IN DRIVES OF PRODUCTION MECHANISMS DUE TO THE OPERATION OF DIGITAL REGULATORS

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 1, Jan 81 pp 37-38

FEOKTISTOV, V. P., candidate of technical sciences

[Abstract] The simplest digital control system consists of a microprocessor and a digital regulator based on reversible counters of the number of a servomechanism position. A level discriminator at the regulator input quantizes the mismatch and an N-digit register at the regulator output fixes the control action of the digital part. In the quasi-steady mode of operation there will occur self-excited

vibrations when all x-axis crossings of the phase trajectories in the phase plane fall outside the insensitivity zone. No self-excited vibrations will occur when at least one crossing point falls inside this zone. Analysis of the drive performance is based on a statistical parameter characterizing the probability of self-excited vibrations, the preset value of the controlled quantity x being arbitrarily oriented relative to the phase trajectories. This arbitrariness is one cause of indeterminacy of the control process. The other cause is the randomness of the delay time of the control signal, this delay time also being accounted for in the analysis rather than being regarded as zero. A typical example is a 200 kV d.c. electric motor supplied through a rectifier from a 400 Hz a.c. source. Figures 3.
[143-2415]

UDC 62-521.001.5:62-752

EXPERIMENTAL STUDY OF THE STABILITY OF A ROTOR IN GAS-TYPE ELASTIC DAMPING SUPPORTS

Moscow MASHINOVEDENIYE in Russian No 2, Mar-Apr 81 pp 89-92
manuscript received 8 Apr 80

LESUKOV, V. A., GROMOV, A. V. and MERZLYAKOV, A. A., Omsk

[Abstract] Mounting gas supports on dampers greatly expands the range of stability of a rotor and ensures the reliable operation of a machine with high rpm. The motion of the rotor/gas support system may be synchronous, fraction-velocity, and half-velocity eddies, according to the parameters of the supports and the damper. The half-velocity eddy for smooth cylindrical gas supports with rigid attachment is particularly critical to velocity which can not be exceeded. An elastic damper suspension of gas supports in the form of a lamellar damper with specific coefficients of charge, specific damper thicknesses, and radial clearances, makes it possible to eliminate a dangerous form of instability in the form of half-velocity eddy at rates of rotation of this eddy that can occur in a rigid support. The advantage of the elastically damped support is that the external damping ensures the stability of the rotor not only under pressurization, but also under gasdynamic conditions of operation. This support has a wide range of stability in synchronous eddy motion of the system; this is more usable than the fractional-velocity eddy since there is no self-oscillating component. Figures 3, references 4 Russian.
Figures 3, references 4 Russian.
[05-5617]

UDC 539.3:534.1

UNSTEADY ELECTROELASTIC OSCILLATIONS OF PIEZOCERAMIC CYLINDERS

Tashkent IZVESTIYA AKADEMII NAUK UZSSR: SERIYA TEKHNICHESKIKH NAUK in Russian No 2, Mar-Apr 81 pp 42-48 manuscript received 2 Sep 79

RAKHMATULIN, Kh. A. and ALLAVERDIYEV, A. M., Moscow Order of Lenin and Order of the Red Banner of Labor State University imeni M. V. Lomonosov

[Abstract] The authors consider the problem of dynamic electrical and mechanical loading of piezoceramic components under unsteady conditions. It is assumed that a radially polarized piezoceramic cylinder with given inner and outer radii is subjected to an electric field that varies arbitrarily with time simultaneously with pressures varying arbitrarily with time on the inner and outer surfaces. In this formulation, wave processes in the cylinder take place simultaneously in the normal and converse piezoelectric effects. A solution is found for the system of equations of the piezoelectric effect, motion, Maxwell's equation for electrostatics and geometric relations, taking the process as adiabatic. The solutions are given in different formulations that not only describe transient processes in the piezoceramic cylinder, but also generalize the previously known solutions. An example is given of numerical computer solution of the problem for the case of zero external pressure and electrical pulse loading with zero initial conditions. References 9 Russian.
[135-6610]

UDC 534.26

RADIATION RESISTANCE OF A CYLINDER WITH ACOUSTICALLY SOFT END FACES

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 27, No 3, May-Jun 81 pp 449-451 manuscript received 24 Dec 79, after revision 3 Jul 80

KOZYREV, V. A. and SHENDEROV, Ye. L.

[Abstract] A previous article by these authors [AKUSTICHESKIY ZHURNAL, Vol 26, No 3, 1980, pp 422-432] examined a method of calculating the acoustic field and impedance of a cylinder of finite altitude for mixed boundary conditions on the surface. The numerical results of that article applied mainly to the case of a cylindrical radiator with hard end faces. Now the authors consider a radiator in the form of a cylinder of given radius and altitude with axisymmetric time-harmonic distribution of the normal component of vibrational velocity assigned on the lateral surface. The acoustic pressure on the end faces of the cylinder is taken as zero. The distribution of the velocity potential or the acoustic pressure on the lateral surface

is determined, and also the distribution of velocity on the end faces of the cylinder. The radiation resistance is then determined from the resultant distributions. It is shown that the active part of the radiation resistance on low frequencies is less for a cylinder with soft end faces than for a cylinder of the same dimensions with hard end faces. Figures 2, references 3: 2 Russian, 1 Western. [136-6610]

EXPERIENCE IN ELIMINATING LOW-FREQUENCY VIBRATION OF T-250/300-240 TURBINES

Moscow ENERGETIK in Russian No 4, Apr 81 pp 9-10

ZAROCHENTSEV, G. G., BELYAKOV, V. M., ZVEGINTSEV, A. V., SAMARENKO, V. N., BROVKIN, B. A. and ASTAKHOV, Yu. I., engineers

[Abstract] The article describes steps taken to eliminate low-frequency (28 Hz) vibrations in bearings 1-4 of some T-250/300-240 turbines installed in heat and electric power plants. The frequency of the vibrations is close to the natural frequency of oscillations of the high-pressure runner of the turbine. The vibration level in the runner is 8-12 times the level in the bearings. To reduce the level of aerodynamic excitation, the ratio of axial and radial clearances of the first to sixth stages of the high-pressure section was reduced by shifting the high-pressure cylinder 0.67 mm closer to the first bearing. The loads on the first and second bearings were redistributed to improve the stability of bearing operation, and the flow section of the high-pressure cylinder was recentered by lowering 0.3 mm. New seals were installed in the flow section of the high-pressure cylinder. Figures 3. [118-6610]

UDC 534.282

CALCULATING VIBRATION-ABSORBING PROPERTIES OF MECHANICAL SYSTEMS BY USING THE PRINCIPLE OF SUPERPOSITION

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: MASHINOSTROYENIYE in Russian No 1, Jan [illegible] pp 15-20 manuscript received 5 Mar 79

CHERNYSHEV, V. M., candidate of technical sciences, docent

[Abstract] Many components of modern machinery operate under complicated stress conditions. Calculation of the vibration-absorbing properties of such systems presents serious difficulties due to inadequate information on the mechanism of

dissipation of energy in materials in the nonaxial stressed state. For this reason, the principle of superposition is sometimes used in calculating vibration-absorbing properties in the complex stressed state. The author analyzes some sources of errors in this method and given quantitative evaluations of these errors. It is shown that in the case of the plane stressed state, the best versions of the principle of superposition introduce errors of up to 20-50%. In the three-dimensional stressed state and at higher amplitudes, these errors are still greater. The invariance of the computational formulas of this method with respect to the angle of inclination of the elements being calculated for vibration-absorbing properties may lead to additional errors of 18-120%. Calculation of the vibration-absorbing properties of actual composite plates shows that the errors in this case amount to 30-50% with the best variant of the principle of superposition. Therefore it is recommended that calculations of this kind be done by the method of equivalent stresses, which gives errors of about 10% in the given case. Figures 3, references 6 Russian.
[125-6610]

UDC 533.6.013.42

NONAXISYMMETRIC OSCILLATIONS OF SHELLS OF REVOLUTION THAT CONTAIN A LIQUID

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA in Russian
No 2, Mar-Apr 81 pp 139-146 manuscript received 3 May 79

RADOVINSKIY, A. L., Moscow

[Abstract] The author considers linear harmonic nonaxisymmetric oscillations of thin shells of revolution closed at the vertex and filled with liquid. The position of points of the shell and the wall layer of liquid is given by the radius-vector of points of the middle surface of the shell plus the coordinate originating on the surface and increasing inwardly in the direction normal to the surface. The characteristic radius of the surface is taken as the unit of length, and it is considered to be small compared with the inwardly increasing coordinate. Expressions are found for the components of the vector of displacements of the middle surface and the potential of displacements of the liquid. The analysis is based on equations of motion of the shell, certain expressions for operators of the theory of shells, the equation of motion of the compressible liquid, the Laplace operator in the wall layer and boundary conditions. Approximate methods are used that are analogous to those given in the literature on statics and dynamics of shells [A. L. Gol'denveyzer, "Teoriya uprugikh tonkikh obolochek" (Theory of Thin Elastic Shells), Moscow, Nauka, 1976; A. L. Gol'denveyzer, V. B. Lidskiy and P. Ye. Tovstik, "Svobodnyye kolebaniya tonkikh uprugikh obolochek" (Free Oscillations of Thin Elastic Shells), Moscow, Nauka, 1979]. References 4 Russian.
[131-6610]

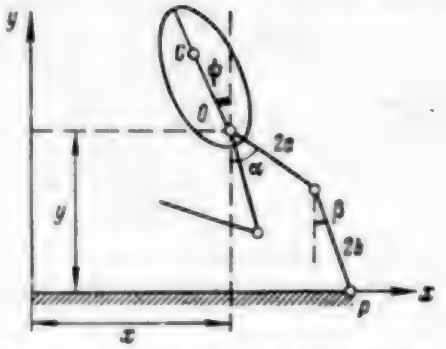
UDC 531.8

MODEL PROBLEM OF BIPEDAL LOCOMOTION

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA in Russian No 2, Mar-Apr 81 pp 156-165 manuscript received 30 May 79

BELETSKIY, V. V. and LAVROVSKIY, E. K., Moscow

[Abstract] An analysis is made of the gait of a bipedal model over a horiztontal surface. Motion is assumed to be planar and uniform in plane xy. The legs are taken as massless so that all the weight is concentrated in the "torso" with center of mass at the point C [see diagram] and in the "platform" situated at point 0 of the "hip" joint, the total mass being equal to the sum of the masses of the torso and platform. The analysis is based on the "comfort" principle [V. V. Beletskiy, "Dynamics of Bipedal Locomotion", IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA, No 3, 1975, p 3, No 4, 1975, p 3]. The properties of periodic solutions of the equation that describes compensating oscillations of the torso are studied in the linear and nonlinear cases. Some dynamic peculiarities of periodic solutions are considered in the nonlinear approximation, and an examination is made of the way that the energy properties of these solutions depend on a number of kinematic and structural parameters. When the torso is moving in the "head downward" mode, a sharp increase is observed in energy requirements and a number of other dynamic characteristics.



Figures 13, references 5: 4 Russian, 1 Western.
[131-6610]

UDC 531/538

SLOW MOVEMENTS OF A CONDUCTIVE SOLID IN A MAGNETIC FIELD

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA in Russian
No 2, Mar-Apr 81 pp 175-182 manuscript received 15 Oct 79

KHODZHAYEV, K. Sh. and SHATALOV, S. D., Leningrad

[Abstract] Averaged equations of motion are given for a mechanical system characterized by a column vector q of generalized coordinates $q_1, \ldots, q_m$, one of whose elements is a conductive solid located in a time-variable magnetic field. It is assumed that forces of electromagnetic origin act only on this conductive body and not on the other elements of the system. The analysis is based on a discrete description of Foucault currents in the body. A method of averaging is used that is simpler than the general method of separation of motions of systems with many fast variables. Expressions are found for dissipative or "pumping" forces in the second approximation, and an analysis is made of the way that the forces depend on the frequency and conductivity of the body. It is established in particular that the average electromagnetic forces in the second approximation are dissipative if the frequency of the field is less than the first eigenvalue of the problem of damping of the proper field of the body. It is shown that a body that can rotate about a stationary point necessarily has a stable equilibrium position. The authors also consider the case of a superconductive body, where it is shown that the average electromagnetic forces in the first approximation are potential for any number of moving superconductive solids and currents setting up an external field.
References 11 Russian.
[131-6610]

TESTING AND MATERIALS

UDC 669.14.018.44:621.224.3:621.791.92

DESIGN STRENGTH OF ACTIVE BLADES RECONDITIONED FOR STEAM TURBINES BY HARD FACING AND HEAT TREATMENT

Moscow ENERGOMASHINOSTROYENIYE in Russian No 5, May 81 pp 20-22, 24

TANANKO, I. A., candidate of technical sciences, POGREPNOY, N. A., engineer, ZOZULYA, V. F., candidate of technical sciences, BUGAYEV, A. M., engineer, BELOLIPETSKIY, Yu. P., candidate of technical sciences, ROMANOV, V. N., engineer, TELESHOVA, Ye. M., engineer, NOZDREV, S. Ya., engineer, and GURSKIY, G. L., engineer

[Abstract] An experimental study was made to establish the feasibility of reconditioning eroded blades of steam turbines by hard facing. Blades from the low-pressure stage of a K-300-240 turbine, made of 15Kh11MF steel, were hard faced over a surface 20-30 mm wide in the peripheral section and 5-15 mm wide in the median section. Subsequent dual heat treatment, tempering and induction case-hardening to a depth of 0.5-1.0 mm was to provide the necessary wear resistance. Tests were done to determine the following properties of blade metal subjected to the simultaneous action of static, dynamic and vibration loads: static strength and ductility in short-term tensile tests, and also sensitivity to brittle fracture in dynamic bending tests on hard-faced specimens; fatigue strength under conditions of symmetric and asymmetric loading cycles on hard-faced specimens; structural fatigue limit in tests of a batch of experimental blades on an electromagnetic vibration stand; erosion resistance of specimens; level and nature of the distribution of residual stresses in hard-faced blades and specimens. The results indicate that hard facing with 20Kh13 steel by this process yields blades with an erosion resistance at the front edge approximately 500% higher than that of new 15Kh11MF blades and 15-20% higher than that of such blades only case hardened, also with a structural fatigue limit of approximately 160 MPa on the basis of 10^7 cycles and thus with a large safety margin. Fracture of such reconditioned blades was found to be ductile and usually not to begin at the hard-faced front edge. Figures 5, tables 2, references 7 Russian.
[137-2415]

UDC 534.833

VIBRATION-ABSORBING COATING BASED ON FOL'GOIZOL [INSUFOIL] FOR DAMPING TUBING VIBRATIONS

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 27, No 3, May-Jun 81 pp 454-456
manuscript received 4 Feb 80

NAUMKINA, N. I., TARTAKOVSKIY, B. D. and YANKINA, Ye. K., Acoustics Institute imeni N. N. Andreyev, USSR Academy of Sciences

[Abstract] "Fol'goizol" is a waterproofing material combining an asphalt material, "izol" with a coating of aluminum foil on one side. Previous research has shown that application of several layers of this material damps vibration of plates like reinforced vibration-absorbing coatings. However, the aluminum foil of the industrially produced material has a quilted pattern that reduces tensile stiffness, eliminating the reinforcing effect on the viscoelastic "izol" layer. The reinforcing action is improved by using smooth aluminum foil, and by cutting the material into sections of an optimum length of 10 cm. Tests are done to determine the vibration-absorbing effectiveness of this modified "fol'goizol" material on a stainless steel pipe. It was found that a covering of four layers of modified "fol'goizol" ensures a coefficient of losses of vibrational energy in the pipe that exceeds 0.06 at frequencies from 50 Hz to 10 kHz. The effectiveness of the modified material is four times the level for the industrial grade. Figures 2, references 3 Russian.
[136-6610]

UDC 539.211:546.79

SPUTTERING THIN METAL FILMS WITH FISSION FRAGMENTS

Moscow ATOMNAYA ENERGIYA in Russian Vol 49, No 4, Oct 80 pp 232-236
manuscript received 28 Sep 79

BITENSKIY, I. S.

[Abstract] The theta-spike model is used as a basis in deriving an expression for the coefficient of sputtering of a metal film with fission fragments, and an examination is made of the particulars of angular distribution of atoms in self-sputtering of fine-grained films. According to the proposed model, interaction with the fission fragment causes an abrupt rise of temperature in the electronic subsystem. With subsequent interaction between the electronic and ionic subsystems, energy is transferred to the ionic subsystem, but the lattice temperature cannot rise by more than 100 K because of the considerable relaxation time. However, a

large number of defects in a film produced by nonequilibrium deposition shortens the length of the free path in electron-phonon interactions, which may increase the transfer of energy to the ionic subsystem and raise the lattice temperature above the melting point. The atoms emitted from the resultant thermal spike (theta-spike) contribute to the sputtering coefficient along with atoms sputtered by development of a cascade of elastic collisions. The proposed expression also gives the coefficient of sputtering in the case of a film made up of isolated grains. Figure 1, references 16: 13 Russian, 3 Western.
[129-6610]

UDC 542.26

VACUUM-TIGHT ADHESIVE SEALING OF OPTICAL WINDOWS IN CRYOSTATS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 2, Mar-Apr 81 pp 236-237
manuscript received 5 Jun 79

KLINKOV, V. K. and NADTOCHIY, Yu. G., Institute of General and Inorganic Chemistry, USSR Academy of Sciences, Moscow

[Abstract] A technique is described for making a gas-tight glass-to-metal cement joint that can withstand repeated cycling from room temperature to the liquid nitrogen point with almost no tension in the glass windows of cryostats. The cement is BF-2 and ED-5 or ED-6 epoxy resin. The resin is filled with glass fiber to overcome the characteristic brittleness and prevent cracking with sharp changes in temperature. The glass window is cemented to a copper retaining ring made of foil or tubing, and the ring is then fastened to the cryostat port by conventional methods. The part of the ring in contact with the quartz window is 0.07 mm thick or thinner,and is tapered 3-4° for seating the window. Etching removes oxide and thins the section for seating the quartz to 0.05-0.045 mm. The sides of the window were 1.5 mm thick, and were ground to a taper of 3-4°. After degreasing, the BF-2 cement was applied as a sublayer, and the epoxy was then applied with polyethylene-polyamine hardener in a weight ratio of 10:1 with addition of glass fibers 1-5 μm thick and 0.5-1 mm long in an amount of 10% by weight. The epoxy was heated to remove air bubbles, thoroughly mixed, and applied to both surfaces. After joining, the cement was polymerized at 60°C for 6 hours without clamping. Stresses in the glass were checked in crossed polaroids. Experience with these seals has shown no leaks after operational use for a year. Figure 1, references 8 Russian.
[130-6610]

UDC 539.23:621.794.415

MAKING FREE SILICON DIOXIDE THIN FILMS BY ETCHING

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 2, Mar-Apr 81 pp 232-233
manuscript received 11 Sep 79

PUNDUR, P. A. and ERNSHTEYNS, R. V., Scientific Research Institute of Solid State Physics, Latvian State University, Riga

[Abstract] A method is proposed for local etching of an oxidized silicon plate with continuous monitoring of the thickness of the plate by the intensity of transmitted light. The device for producing a silicon dioxide film is shown in the diagram. Silicon plate 5 carrying the silicon dioxide film is placed on a step inside cylinder 3. A plate of KI glass 6 prevents the loosened silicon dioxide film from being torn by the pressure of etchant 2, and also keeps the etchant away from the photoresistor below. Cylinder 1 is pushed into outer cylinder 3 to hold the silicon plate being treated. The inside diameter of cylinder 1 determines the size of the opening to be etched in the silicon. Both cylinders are made of Teflon. The etchant is poured into the inner cylinder. The lower part of the inner cylinder is smeared with vacuum sealant 4 that is resistant to the etchant. This coating can also be used for additional variation of the hole to be etched. The completion of silicon etching is determined by the reading of the microammeter connected in the circuit of the FSK-12 photoresistor. Since silicon is opaque to visible light, while silicon dioxide is transparent in the visible range, the light from the incandescent lamp does not fall on the photoresistor with resultant increase in current through the meter until the silicon has been etched away. The etchant is an acid mixture of $HF:HNO_3:AgNO_3 = 1:4:4$, which acts on silicon at a rate 70 times faster than on silicon dioxide. Upon completion of etching, the entire facility is rinsed with deionized water, and the sealant is removed. Films up to 5 mm in diameter were produced by this technique.

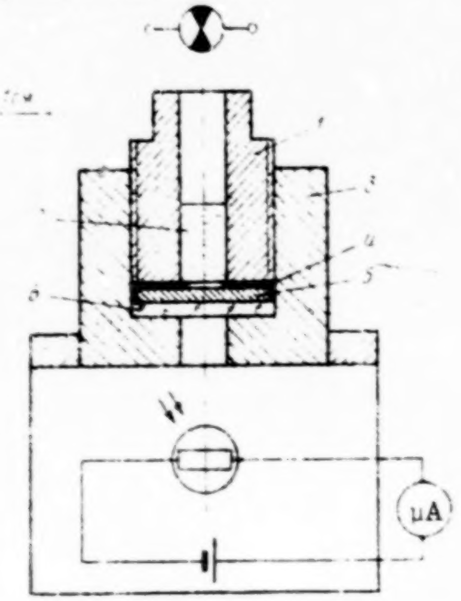


Figure 1, references 2 Russian.
[130-6610]

UDC 539.234

MAKING TUNNEL JUNCTIONS ON THE SURFACE OF ALUMINUM SINGLE CRYSTALS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 2, Mar-Apr 81 pp 230-232
manuscript received 21 Aug 79

DOROZHKIN, S. I., Institute of Solid State Physics, USSR Academy of Sciences, Moscow

[Abstract] Experiments on tunneling of electrons through a thin layer of dielectric yield valuable information on the properties of metals between which tunneling takes place. The oxide layer that exists on aluminum under ordinary conditions is too thick for tunneling current to flow through. The author investigates a method of making tunnel junctions by using argon ion bombardment followed by annealing in vacuum to produce an atomically pure and perfect aluminum surface. Specimens in the form of plates measuring 2 x 1 x 0.3 mm were cut from a single crystal. The wide face was parallel to crystallographic plane (110). The initial material had a resistance ratio of $\rho_{300_K}/\rho_{4.2_K} = 2\cdot 10^4$. The specimens were polished and treated in a 10% solution of NaOH. The specimens were then placed in a vacuum chamber and bombarded with argon ions for 3 hours, followed by annealing at 500°C in a vacuum of $5\cdot 10^{-9}$ mm Hg for 12 hours with subsequent cooling for 2 hours. The specimens were oxidized in strict schedules and then sputtered with films of tin or silver to produce tunnel junctions between the aluminum single crystal and the superconductor (Sn) and between the Al and a normal metal (Ag). All operations were done in the same vacuum chamber without opening. An example is given of the current-voltage curve for an Al-Sn tunnel junction at 78 K. Figures 3, references 2 Western.
[130-6610]

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